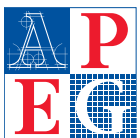
A photograph of a forest stream with a log bridge. The stream flows over rocks, and the bridge is made of several large logs. The background is a dense forest of tall trees.

Guidelines for Professional Services in the Forest Sector – Crossings



Professional Engineers
and Geoscientists of BC





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Cover: Kootenay Lake Forestry Centre, Powder Creek Road. Km
33 Murphy Creek Crossing. Photo: Les Thiessen, P.Eng.



1.0 GENERAL

1.1 Introduction

1.1.1 Forest development requires the planning, design, construction, inspection and maintenance of forest road bridges and *Engineered Culverts*. Forest resource managers rely on professionals to provide the appropriate services for a given set of conditions at a particular site for an existing or proposed *Crossing*. However, professionals must only practice in areas where they are appropriately trained and experienced. *Professional Engineers* and *Professional Geoscientists* “shall undertake and accept responsibility for professional assignments only when qualified by training or experience”¹. *Forest Professionals* have a responsibility “to practice only in those fields where training and ability make the member professionally competent”².

1.1.2 These guidelines set out general standards of professional practice that the *Professional Engineer* and the *Forest Professional* must, subject to Section 1.4.1, meet when providing professional services related to a *Crossing* project. They have been prepared by the Joint Practice Board of the Association of British Columbia Forest Professionals (ABC FP) and the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) (collectively the Associations) and have been adopted by the Council of each Association.

1.1.3 These guidelines are based on the following concepts:

- .1 adherence to the *Engineers and Geoscientists Act*, R.S.B.C. 1996 c. 116 as amended;
- .2 adherence to the *Foresters Act*, S.B.C. 2003 c. 19;
- .3 building upon the design team concept; and
- .4 relying on the professionalism, experience and education of *Professional Engineers* and *Forest Professionals*.

1.1.4 Delivery of professional services for a *Crossing* can involve the practice of professional forestry and professional engineering. The *Foresters Act* includes, within the definition of the practice of professional forestry, “planning, locating and approving forest transportation systems including forest roads”. The *Engineers and Geoscientists Act* includes, within the definition of the practice of professional engineering, “design or directing the construction of public utilities, industrial works, railways, bridges ...”. There is long-standing historical involvement of *Members* of each profession with respect to *Crossing* projects.

1.1.5 Government has granted specific professional associations the legislative authority to regulate resource professionals working in the forest sector. The regulatory authority includes determining which professional activities should be carried out by *Members* of which professional association and addressing matters related to areas of overlap.

1.1.6 The Joint Practice Board was specifically mandated by the Councils of the ABCFP and the APEGBC under a Memorandum of Understanding originally signed in 1994 and updated in 2006, to make

1 APEGBC Bylaw 14(a)(2)
2 ABCFP Bylaw 11.3.7



recommendations to their respective Councils on matters related to the overlap between the professions. The ABCFP and the APEGBC are committed to improving the quality of services members provide to clients, employers and the public. These guidelines have been published for that purpose.

1.1.7 In the event of any inconsistencies or contradictions between these guidelines and legislation (including the *Engineers and Geoscientists Act* and the *Foresters Act*), the latter shall prevail.

1.2 Purpose of these Guidelines

1.2.1 These guidelines set out general standards of professional practice that *Members* of APEGBC and ABCFP must, subject to Section 1.4.1, meet in providing professional services related to *Crossing* projects.

1.2.2 *Members* must always exercise professional judgment when providing services, therefore, the application of these guidelines may vary depending on the circumstances.

1.2.3 These guidelines may be used to assist in establishing the scope of work and terms of *Members'* service with their client or employer.

1.2.4 These guidelines are intended to establish standards of practice that *Members* should meet to fulfill professional obligations, including the duty to protect the safety, health and welfare of the public and the environment. Failure to meet the intent of these guidelines could be evidence of unprofessional conduct and may give rise to disciplinary proceedings by the ABCFP or the APEGBC.

1.2.5 The Associations support the proposition that *Members* should receive fair compensation for professional services, adequate to ensure that the professional services delivered can be carried out appropriately. Low fees are not a justification for services that do not meet the standards set out in these guidelines. *Members* may wish to discuss these guidelines with their clients or employers when receiving instructions for an assignment and reaching agreements regarding compensation.

1.2.6 When *Professional Engineers* are involved in a *Crossing* project, they must provide the following notification in accordance with the *Engineers and Geoscientist Act* and Bylaw 17(a) related to liability insurance:

“Before entering into an agreement to provide professional engineering or registered professional geoscience services to the public, a member, licensee or certificate holder must notify the client, in writing, whether or not professional liability insurance is held and whether that insurance is applicable to the services in questions. The note shall include a provision for an acknowledgement of the advice to be signed by the client.”



1.3 Scope of these Guidelines

1.3.1 These guidelines apply to all phases of a *Professional Engineer's* or *Forest Professional's* involvement in a *Crossing* project including:

- .1 project organization and assignment of responsibilities;
- .2 planning and design:
 - .1 general considerations
 - .2 hydrology and hydraulics
 - .3 plans and supporting documents
 - .4 approaches and alignment
 - .5 *Foundations and Substructures*
 - .6 *Superstructures*
- .3 construction and field reviews; and
- .4 inspections.

1.3.2 These guidelines establish the requirements for, and specify the tasks that should generally be performed by, the *Coordinating Registered Professional* (as defined below) in order to meet an appropriate standard of practice that addresses the best interests of the public, the environment and the project.

1.3.3 Every *Crossing* project must have a *Coordinating Registered Professional*. The *Coordinating Registered Professional* is responsible for the coordination of all of the services required for the *Crossing* project, in accordance with Section 2.2.2, planning/design in accordance with Section 2.2.3 and field reviews, as-built drawings and *Crossing* assurance in accordance with Section 2.2.4. The *Coordinating Registered Professional* must appreciate that while they may, in their professional discretion, delegate tasks to others the overall responsibility for the *Crossing* remains with the *Coordinating Registered Professional*. In working under the direct supervision of a *Coordinating Registered Professional* a *Registered Forest Technologist* can play a key role in carrying out the various tasks associated with the completion of a *Crossing* project.

1.4 Professional Conduct

1.4.1 Notwithstanding the purpose and scope of these guidelines, the decision of a *Professional Engineer* or *Forest Professional* not to follow one or more aspects of these guidelines does not necessarily mean that they have failed to meet the appropriate standard of practice in the performance of their professional services. Such judgments and decisions depend upon an evaluation of all facets and circumstances in a particular project.

1.5 Definitions

All definitions contained in this section are strictly for the purposes of these guidelines.

Coordinating Registered Professional

The *Coordinating Registered Professional* is a *Registered Professional Forester* or a *Professional Engineer* who is a *Member* in good standing of the ABCFP or APEGBC. For *Simple Crossings* the *Coordinating*



Registered Professional may be either a *Registered Professional Forester* or a *Professional Engineer*. For all other *Crossings* the *Coordinating Registered Professional* must be a *Professional Engineer*. The *Coordinating Registered Professional* either completes the necessary tasks for coordination, planning/design, conducting field reviews and preparing as-built drawings for a *Crossing* directly, or directs those activities with sufficient oversight and supervision such that they can take overall responsibility and accountability for the project. In the case of a *Simple Crossing* the majority, if not all, of the necessary tasks can be undertaken by the *Coordinating Registered Professional*.

Crossing

A forest road bridge or engineered *Culvert*.

Culvert

A pipe, arch, box or log structure six metres or less centre-to-centre of bearing, covered with soil and lying below the road surface used to carry ephemeral or perennial stream flow in a stream channel from one side of a road to the other.

Design Bearing Pressure

The pressure applied to the soil or bedrock by the foundation unit.

Field Splice

Refers to girders where webs or flanges require a *Field Splice* connection during installation.

Forest Professional

Is a person admitted under Section 14 of the *Foresters Act*, as either a *Registered Professional Forester*, holder of a special permit entitled to practice as a *Registered Professional Forester* within this field of practice or a *Registered Forest Technologist*.

Foundation

A system or arrangement of structural members, which may include concrete strip or spread footings or piles, through which loads from a structure are transferred to supporting soil or rock.

Engineered Culvert

Is a *Crossing* where:

1. the *Crossing* is used to carry ephemeral or perennial stream flow in a stream channel from one side to the other;
2. the *Coordinating Registered Professional* must be a *Professional Engineer*;
3. the *Crossing* is not a log/wood *Culvert*; and
4. the *Crossing* is a *Culvert* that:
 - a. is one of the following:
 - i. a pipe having a diameter of 2000 mm or greater;
 - ii. a pipe arch having a span of 2130 mm or greater;
 - iii. an open bottom arch having a span of 2130 mm or greater; or
 - b. has a maximum design discharge of 6 m³/s or greater.



Member

A registered *Member* in good standing with the ABCFP or the APEGBC.

Non-composite

A *Superstructure* system that does not require its sub components (such as girders and concrete deck) to be structurally connected on site to deliver its primary design capacity.

Non-skewed

Is a *Superstructure* that is rectangular or square in plan.

Professional Engineer

A person who is registered or licensed as a *Professional Engineer* under the *Engineers and Geoscientists Act*.

Registered Professional Forester

A person admitted under Section 14 of the *Foresters Act* as a *Registered Professional Forester* or a holder of a special permit entitled to practice as a *Registered Professional Forester* within this field of practice.

Registered Forest Technologist

A person admitted under Section 14 of the *Foresters Act* as a *Registered Forest Technologist*.

Simple Crossing

Is a *Crossing* as defined in Section 3.0 of these guidelines, but does not include an *Engineered Culvert*.

Single Span Simply Supported

Means *Crossings* with no pier, middle support or needle beams so that *Substructure* components will only be found at the ends of the *Superstructure*.

Specialist

A *Specialist* is responsible for providing one or more services required for a *Crossing* project at the request of and under the supervision of the *Coordinating Registered Professional*. Examples of persons who may be *Specialists* include: *Professional Geoscientists*, *Registered Forest Technologists*, registered professional biologists, *Professional Engineers* and *Registered Professional Foresters*.

Substructure

The *Substructure* is that portion of the *Crossing* that rests on the *Foundation* and below the *Superstructure* and generally consists of log cribs, interlocking concrete blocks, or steel towers with footings. In some instances, such as interlocking concrete blocks without footings the *Substructure* and *Foundation* are synonymous.

Superstructure

The *Superstructure* is that portion of the *Crossing* that rests on the *Substructure* and provides the traveling surface for the *Crossing*. It generally consists of stringers, decking and guardrails.



2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Teamwork

2.1.1 Teamwork is essential to achieve the best outcome for a *Crossing* project. A team will generally consist of a *Coordinating Registered Professional* who is qualified and competent to oversee the *Crossing* project and take full responsibility for the *Crossing* project in its entirety, and one or more *Specialists* required for any part of the *Crossing* project.

2.2 Responsibilities of the Coordinating Registered Professional

2.2.1 The *Coordinating Registered Professional* is responsible for all the professional services for the *Crossing* project including coordination, planning/design, field reviews, as-built drawings and *Crossing* assurance as described below.

2.2.2 Coordination

The *Coordinating Registered Professional* must:

- .1 coordinate activities relating to the *Crossing* project in the context of the overall development, and confirm that the necessary assessments for the project have been completed;
- .2 consider applicable governing legislation and determine that required approvals, licenses and permits from the appropriate government agencies have been obtained;
- .3 understand all generally accepted uncertainties inherent in the *Crossing* project and assumptions made in relation to the project, including assumptions made by the *Specialists*;
- .4 oversee and take professional responsibility for all coordinating work done under their direct supervision;
- .5 have an understanding of the roles and responsibilities of all the people involved in the planning, design and construction of the *Crossing* project;
- .6 utilize *Specialists* in the planning, design and construction process of a *Crossing* where required and consider information received from *Specialists* and where appropriate incorporate the information into the plan/design;
- .7 provide all *Specialists* with the relevant information; and
- .8 determine whether or not the *Specialists* involved hold professional liability insurance applicable to the services being provided.

2.2.3 Planning/design

In order to complete an appropriate plan the *Coordinating Registered Professional* must:

- .1 consider conditions of the specific site location, site plan and installation;
- .2 gather site information, including the site plan and other information which may impact the proposed *Crossing*. This information may be gathered directly or by persons working under the direct supervision of the *Coordinating Registered Professional*;
- .3 take overall responsibility for the conceptual plan and general arrangement drawings and provide



input for necessary changes required in the field (such changes may include improved alignment of the *Crossing* or road centreline changes to ensure appropriate approach alignments are obtained);

- .4 address environmental concerns in the plan; and
- .5 reviewing structural designs for the fabrication of *Crossing* components.

2.2.4 Field Reviews, As-Built Drawings and Crossing Assurance

In order to determine whether the *Crossing* construction has been completed in general conformance with the plan, the *Coordinating Registered Professional* must:

- .1 undertake field reviews during the construction of the *Crossing* and determine the timing and extent of such field reviews. When the *Coordinating Registered Professional* is a *Professional Engineer*, he/she must ensure that the requirements of Quality Management Bylaw 14(b)(4) of the *Engineers and Geoscientists Act* are met. Under the requirements of this bylaw, field reviews must be carried out on the project during construction. In meeting the intent of the bylaw, the responsibility for design and field reviews does not necessarily mean that the *Coordinating Registered Professional* must personally conduct all design and field reviews, but must see that they are carried out under his/her direct supervision such that he/she can take responsibility and provide the *Crossing Assurance Statement*. When the *Coordinating Registered Professional* is a *Registered Professional Forester*, he/she must ensure that the requirements under the definition of the “practice of professional forestry” in Section (d) of the *Foresters Act* “auditing, examining and verifying the results of activities involving the practice of professional forestry, and the attainment of goals and objectives identified in or under professional documents” have been achieved. When the *Coordinating Registered Professional* is a *Registered Professional Forester* the utilization of a *Registered Forest Technologist* is appropriate under Section 20(2)(b) of the *Foresters Act*;
- .2 where changed conditions are encountered during construction, provide revisions to the original plans and supporting documents;
- .3 gather all relevant information and prepare as-built drawings and sign and seal a *Crossing Assurance Statement* after the *Crossing* project is completed, giving an assurance that the *Crossing* has been built in general conformance with the plans and supporting documents; and
- .4 retain copies of the planning and design file, as built construction documentation and *Crossing Assurance Statement* on file and provide a copy to the licensee (if applicable).

2.3 Responsibilities of the Specialist

2.3.1 A *Crossing* project may require the use of one or more *Specialists*.

2.3.2 The specialist will be responsible for the following:

- .1 obtaining relevant project information from the *Coordinating Registered Professional*;
- .2 carrying out the specific duties and tasks that have been assigned to the *Specialist* by the *Coordinating Registered Professional*;
- .3 overseeing and taking professional responsibility for all work carried out under the *Specialist*'s direct supervision.



2.3.3 Where a *Registered Forest Technologist* is used, the *Coordinating Registered Professional* continues to have overall professional responsibility for the *Crossing* and must sign off on both the plan and as-built drawing as well as the *Crossing Assurance Statement*. A *Registered Forest Technologist* may execute, supervise the execution of or inspect work designed by a *Professional Forester* admitted under Section 14 or special permit holder acting within the scope of their permit as per Section 20(2)(b) of the *Foresters Act*. When doing so the *Registered Forest Technologist* is professionally responsible for the work they execute, supervise or inspect.



3.0 SELECTION CRITERIA FOR THE COORDINATING REGISTERED PROFESSIONAL

3.1 Simple Crossings

3.3.1 A *Registered Professional Forester* may be the *Coordinating Registered Professional* for *Simple Crossings* where all of the following conditions are met for the duration of the *Crossing* project:

3.2 Conditions

3.2.1 General requirements:

- .1 plans must be prepared using structural details provided in drawings, tables, charts and other design aids that have been prepared by a *Professional Engineer*. The *Crossing* components (*Superstructure*, *Substructure*, connections) must all have been designed to be used in the general combination and configuration shown on the plans by the design aids. All design aids must be referenced on the plans and supporting documents;
- .2 limitations on the design aids, if any, must be referenced on the plans and their affect, if any, on the plans documented; and
- .3 factored dead loads and live loads, must impose less than 200 kPa *Design Bearing Pressure* on the *Foundation* soils or bedrock unless a higher *Design Bearing Pressure* is authorized by a design aid prepared by a *Professional Engineer*.

3.2.2 Hydrology and Hydraulics:

- .1 the channel must be historically stable with erosion resistant banks; or
- .2 the channel may be historically unstable where the *Coordinating Registered Professional* has determined that it is acceptable for the *Crossing* and/or the approaches to be damaged or destroyed during design flow events and this has been referenced on the plans.

3.2.3 Approaches, alignment and gradient:

- .1 the native ground at the approaches must be determined to be stable, based on field reviews;
- .2 excluding log structures, the road approach shall be aligned to assure that the design vehicle tracks straight on to and off of the *Crossing* with no side tracking; and
- .3 the maximum *Crossing* grade shall be four percent, excluding log structures with gravel decks.

3.2.4 *Foundation* soils or rock:

- .1 It is assumed that the *Foundation* soils or bedrock can safely support a *Design Bearing Pressure* of 200 kPa or more if it is composed of unweathered bedrock free of adverse jointing and discontinuities, dense glacial till, or dense sandy gravel. These ground conditions should be adequate to support the anticipated loads with acceptable settlement (less than 25 mm total and differential) provided that subsection 3.2.5.2 through 3.2.5.6 are met and the following conditions also apply:
 - .1 the normal groundwater table is a minimum of 1 m below the base of the footings if on



- soil;
 - .2 the bearing surface has less than a 5 % slope in any direction;
 - .3 there is no evidence of instability in the vicinity of the *Crossing* that could impact the proposed structure;
 - .4 the footing bears on undisturbed soil, bedrock or a modest thickness of granular fill as described below; and
 - .5 a modest thickness of granular fill can be utilized to level the footing area provided that the fill is compacted to a minimum of 95% of the standard proctor maximum dry density, the total thickness of the fill does not exceed 0.3 m and the natural ground surface below the fill meets all of the above criteria.
- .2 It is recognized that soil and bedrock types and conditions vary from place to place in BC. In some areas the soil or bedrock on which the *Foundations* sit may not be able to support a *Design Bearing Pressure* of 200 kPa due to local or temporary conditions. In these cases it may be possible to develop geotechnical design aids for local or temporary use in order for the *Crossing* to qualify as a *Simple Crossing*. These design aids must:
- .1 be developed by a *Professional Engineer* and define the design and construction circumstances to which the design aids are to be used;
 - .2 clearly define the specific soil and bedrock types and conditions and the *Design Bearing Pressure* which is allowable in terms of what the soil or bedrock can safely support;
 - .3 delineate the geographic area within which the design aids are to be used;
 - .4 explain any limitations in the application of the design aids such as restrictions on site preparation techniques, *Foundation* configurations or construction methods; and
 - .5 indicate any field checks to be made by the *Professional Engineer* to check the validity of the design aids and application.

3.2.5 *Substructures:*

- .1 If constructed of log sills or log cribs, *Substructures* must be 4 m or less in height or if constructed of interlocking concrete blocks (with or without concrete footings) must be 2 m or less in height (including sills and caps). Plans for *Substructures* must be prepared using design aids prepared by a *Professional Engineer*.
 - .1 The 4 m height limitation for log cribs is measured from the lowest point of the *Substructure* where it bears on the *Foundation* soils or rock to the top of the bearing sill or bridge soffit. Sills and caps are transitions to connect the *Superstructure* to the *Substructure* and are included as part of the maximum allowable *Substructure* height.
 - .2 Increasing the *Substructure* height greater than the values above (4 m high log cribs and sills or 2 m high interlocking concrete blocks) by combining different *Substructures* together is not permitted. For example a 3 m log crib with 1.5 m concrete lock blocks on top does not qualify as a *Simple Crossing*.
- .2 If using concrete footings they are to be no less than .75 m wide in the smallest dimension.
- .3 If using log or timber sills they are to be no smaller than 0.4 m width at its narrowest.
- .4 The footing and sills may vary from the widths described above so long as they follow design aids prepared by a *Professional Engineer*.
- .5 The footings or sills must span the entire width of the *Foundation*.
- .6 The base of the footings is setback at least 1.5 m horizontally from a two horizontal to one



vertical plane extrapolated upwards from the toe of soil slopes or 1.5 m back from the crest of the slope, whichever is greater.

3.2.6 Superstructures must:

- .1 be non-composite;
- .2 be *Single Span Simply Supported*;
- .3 incorporate structural designs that have been prepared by a *Professional Engineer* for the loading configuration required;
- .4 have plans developed with the aid of tables prepared by a *Professional Engineer* if consisting of log stringers;
- .5 not require engineered installation procedures (for example specialized lifts or specialized launches);
- .6 not require field splices;
- .7 not require structural field welding or structural concrete grouting; and
- .8 be *Non-skewed* (excluding log structures).

3.3 Other Crossings

- 3.3.1** A *Professional Engineer* may be the *Coordinating Registered Professional* for a *Simple Crossing* and must be the *Coordinating Registered Professional* for all other *Crossings*.



4.0 GUIDELINES FOR PROFESSIONAL PRACTICE

4.1 Planning and Design

4.1.1 General Considerations

4.1.1.1 The services the *Coordinating Registered Professional* should consider, as part of appropriate practice in planning and designing a *Crossing*, are outlined below. This outline can assist in explaining the scope of work for planning and designing a *Crossing*. However, this outline is not intended to be exhaustive and professional judgment is required when determining the specific services necessary for any project.

4.1.1.2 The *Coordinating Registered Professional* should have a good understanding of all facets of planning and designing a *Crossing*. Consideration shall be given to all design factors in a holistic approach, understanding how the factors integrate, impact and influence the overall plan. Awareness of the limitations of field assessment data is very important when considering the factors influencing a plan and installation. These limitations need to be accounted for in the plan as changes in field conditions may occur once installation commences. When made, field construction changes need to take into account all other considerations.

4.1.1.3 Prior to taking on the task of the *Coordinating Registered Professional*, consideration should be given to the likelihood and severity of an adverse effect to public safety, public and private property, the environment, utilities, water supplies, water quality and quantity, sedimentation, fish habitat and the transportation system that could potentially be caused by the *Crossing*. The *Coordinating Registered Professional* can only accept and take responsibility for those projects for which they are equipped with the necessary skills and knowledge.

4.1.1.4 Bridge design and fabrication must be completed in accordance with accepted engineering practice including; appropriate application of the current version of the *Canadian Highway Bridge Design Code* (CAN/CSA S6) and the *Canadian Foundation Engineering Manual*, and take into account the effect of logging trucks with unbalanced loads and off-centre driving.

4.1.1.5 Where the *Coordinating Registered Professional* is a *Professional Engineer*, he or she must determine that the requirements of Quality Management Bylaws 14(b)(1 - 4) of the *Engineers and Geoscientists Act* are met in terms of retention of design and review files for a minimum of 10 years, carrying out in-house checks of their designs and having independent concept reviews carried out on the structural designs and carrying out field reviews respectively.

4.1.2 Hydrology and Hydraulics

4.1.2.1 Hydrology and hydraulic factors are basic to the planning and designing of a *Crossing* and roadway and can affect the road location. Inadequate consideration of hydraulic factors can result in problems, increased maintenance costs, failure or unnecessarily expensive *Crossings*. Environmental changes



at the *Crossing* may have impacts at a considerable distance from the *Crossing*, such as morphological changes that may affect the river upstream and downstream. Hydrology and hydraulic factors must be considered as part of the overall *Crossing* plan and are the responsibility of the *Coordinating Registered Professional*.

4.1.2.2 An appropriate design flow must be determined for the particular site. Determining design flow usually involves applying several different methods and then applying judgment to select an appropriate design value. The *Coordinating Registered Professional* should compare flow discharge estimates derived from the site information with other data and theoretical derivations. The final selection of design flow should then be based on the *Coordinating Registered Professional's* or *Specialist's* judgment, taking into account these derivations. Using a simplistic calculation such as “three times high water area” is not suitable as the primary or only means of design flow analysis for *Crossings*.

4.1.2.3 The *Coordinating Registered Professional* must translate the determined design flow into the hydraulic impacts on the proposed site, channel and *Crossing*. Hydraulic analysis is necessary to determine the required waterway opening and structure configuration, as well as the assessment for scour potential and the appropriate means of scour protection. The waterway opening and *Crossing* configuration should be based on the *Coordinating Registered Professional's* judgment and should also take into account consideration of debris potential, ice jams or other local factors that might influence the *Crossing* opening, alignment and configuration.

4.1.3 Plans and Supporting Documents

4.1.3.1 The *Coordinating Registered Professional* must communicate the project objectives to others in a clear, concise and detailed manner. This is usually accomplished through plans/design drawings and supporting documents. Typically, general arrangement drawings will show the location, composition and arrangement of the proposed *Crossing* in relation to the specific site, as well as include specific requirements and measures for installation. Where design aids produced by *Professional Engineers* have been used in producing the plans they must be referenced on the plans. The plans/design drawings and supporting documents must be sealed by the *Coordinating Registered Professional*.

4.1.3.2 General arrangement drawings are the outcome of the planning or design process. General arrangement drawings should clearly depict the proposed components and configuration of the *Crossing* in relation to the forest road, stream and stream banks. General arrangement drawings are developed from the site plan, profile drawings and conceptual plans or designs. General arrangement drawings must be sealed by the *Coordinating Registered Professional*.

4.1.3.3 A complete set of plans generally consists of the general arrangement drawings supplemented with detailed *Superstructure* and *Substructure* drawings, and other fabrication, material and construction specifications. Shop drawings are prepared by material fabricators to detail and in many cases complete the structural design of *Crossing* components. These drawings will form part of the drawing set and should be retained as part of the file documentation. For reference purposes the *Coordinating Registered Professional* can refer to current versions of the *Forest Road Engineering Guidebook*, *Forest Service Bridge Design and Construction Manual* or any other appropriate documents.



4.1.3.4 The complete set of plans/design drawings should provide comprehensive details on the location, composition, arrangement, design parameters and fabrication, materials and construction specifications for the proposed *Crossing*. Plans are an integral part of the planning process to be completed before construction begins.

4.1.4 Approaches and Alignment

4.1.4.1 Approaches are those sections of road on either side of the *Crossing*, extending for a sufficient distance to allow for the safe passage of the design vehicle over the *Crossing*. The approaches include the vertical and horizontal road alignment, curve radius and widening considerations and turnouts, surface drainage and related safety issues such as visibility and signage. The approaches and adjacent road alignment must be considered in the overall plan and installation of the *Crossing*.

4.1.4.2 A *Crossing* and its approaches must be aligned precisely to accommodate side tracking of the design vehicle. For many *Crossings*, the *Coordinating Registered Professional* will undertake quantitative analysis of design vehicle tracking to determine optimum approach road widths and curve radii. In some cases, *Crossing* dimensions need to be altered to accommodate the design vehicle. Alterations may include skewed abutments and flared *Crossing* ends. These modifications result in increased structural complexity.

4.1.4.3 Approach road planning must also address issues related to sight lines, design speed, slope stability, and drainage. The *Coordinating Registered Professional* must also consider riparian impacts. The alignment of a *Crossing* and road prism relative to a stream can influence stream hydraulics. To accommodate hydraulic and attendant erosion issues, *Crossing* characteristics and dimensions of the alignment may have to be altered. The *Coordinating Registered Professional* must determine a cost-effective accommodation of design vehicle requirements, *Crossing* dimensions and expected stream behaviour while minimizing impact to the environment.

4.1.5 Foundations and Substructures

4.1.5.1 Site conditions which include *Foundation* soils or rock and proposed fills should be described and classified. Their relevant strength and drainage characteristics should be established to allow items such as; the allowable bearing pressure, the allowable extent and gradient of excavations and the type and amount of fill, to be determined. The design of retaining structures must address the extent of the lateral earth pressures, drainage characteristics of the backfill, degree of compaction and the internal, external and global stability of the retained fill.

4.1.5.2 The designing and placement of *Crossing Substructures* or *Engineered Culverts* is governed by present and anticipated site conditions. Natural channel banks and escarpments should be assessed to identify any potentially unstable slopes at or adjacent to the proposed *Crossing*, given the proposed applied loads. Approach excavations or fills and their *Foundations* should be reviewed to determine that they will remain stable under design conditions for the life of the *Crossing*.



4.1.6 Superstructures

4.1.6.1 *Superstructure* design is limited to *Professional Engineers* who have the appropriate skills and knowledge. This does not preclude a *Registered Professional Forester* from utilizing design aids prepared by a *Professional Engineer* for their *Simple Crossing Superstructure* plans. Independent concept reviews must be carried out on all structural designs or design aids prepared by a *Professional Engineer*.

4.1.6.2 The detailed design of a *Superstructure* should be guided by a conceptual *Crossing* drawing and should be undertaken as part of the overall *Crossing* location and plan. The *Coordinating Registered Professional* should determine whether the design of the *Superstructure* has accommodated the overall objectives of the *Crossing*, such as anticipated loads and structural requirements, life span of the structure, availability of materials and equipment, environmental risks, road alignment, sediment control, etc.

4.1.6.3 A *Professional Engineer*, with the appropriate training and experience in *Superstructure* design, shall be responsible for the following:

- .1 preparation of drawings, tables and charts for all superstructures, including log stringer *Superstructures*;
- .2 assessment of portable *Superstructures* prior to use where structural damage or deterioration has been identified (refer to Section 4.3, Inspections); and
- .3 incorporation of design loads, design life, intended use and related usage questions.

4.2 Construction and Field Reviews

4.2.1 General

4.2.1.1 The construction of a *Crossing* may include the preparation and assembly of components of the *Crossing* including the following:

- .1 site preparation and alignment;
- .2 abutments and piers;
- .3 caps and sills;
- .4 stringers;
- .5 deck;
- .6 guardrails and guard logs;
- .7 assembly and embedding of *Culvert* sections; and
- .8 approach structures and signage.

4.2.1.2 Where the *Coordinating Registered Professional* is a *Professional Engineer*, he or she must determine that the requirements of Bylaw 14(b)(4), field reviews, have been carried out on the project during construction. In meeting the intent of the Bylaw, the responsibility for design and field reviews does not necessarily mean that the *Coordinating Registered Professional* must personally conduct all design and field reviews, but the *Coordinating Registered Professional* must see that they are carried out under his or her direct supervision so that he or she can sign and seal the necessary *Crossing Assurance Statement*.



4.2.1.3 Where the *Coordinating Registered Professional* is a *Registered Professional Forester*, he or she must determine that the requirements under the definition of the “practice of professional forestry” in Section (d) of the *Foresters Act* “auditing, examining and verifying the results of activities involving the practice of professional forestry, and the attainment of goals and objectives identified in or under professional documents” have been achieved so that he or she can provide the necessary *Crossing Assurance Statement*.

4.2.1.4 The responsibility for what field reviews to undertake, and who should undertake those field reviews, is necessarily left to the judgment of the *Coordinating Registered Professional*. The *Coordinating Registered Professional* must appreciate that while tasks can be delegated to employees, colleagues and subcontractors the overall responsibility for the *Crossing* remains with the *Coordinating Registered Professional*. The *Coordinating Registered Professional* must consider whether to conduct field reviews during the following construction activities:

- .1 layout;
- .2 *Foundation*;
- .3 component assembly;
- .4 erosion control measures; and
- .5 approaches.

4.2.1.5 Non-professionals can be utilized on site for the construction and field reviews of the structures, however, the *Coordinating Registered Professional* is responsible for assuring that the construction is in general conformance with the plans and supporting documents. After construction of a *Crossing*, the *Coordinating Registered Professional* must sign and seal the *Crossing Assurance Statement* indicating that the entire *Crossing* is in general conformance with the plans and supporting documents. The *Crossing Assurance Statement* is attached as Appendix A.

4.3 Field Reviews and Inspections

4.3.1 Final Field Review

4.3.1.1 The initial site field review, other necessary field reviews during construction and the final post construction field review are the responsibility of the *Coordinating Registered Professional*. A final field review must be carried out on all *Crossings* upon completion of construction and prior to initial vehicle usage. The *Coordinating Registered Professional* must provide a recommendation for the frequency of routine maintenance inspections with a maximum frequency of no more than 3 years. Any specialized items requiring specific or special monitoring should be identified by the *Coordinating Registered Professional* for subsequent inspections.

4.3.2 Routine Maintenance Inspections

4.3.2.1 Routine maintenance inspections are beyond the scope of these guidelines. However when carried out, routine maintenance inspection reports must be signed and sealed by a *Professional Engineer* or *Forest Professional*.



APPENDIX A

CROSSING ASSURANCE STATEMENT

(To be retained by the Coordinating Registered Professional and placed on file for the life of the structure.)

| | |
|--|------------------------|
| DESCRIPTION OF PROJECT COVERED BY THIS STATEMENT | |
| ROAD / LOCATION | |
| DISTRICT (IF APPLICABLE) | REGION (IF APPLICABLE) |

This is to advise that I am the Coordinating Registered Professional for the above described crossing and I am a (check appropriate);

- Registered Professional Forester registered with the Association of British Columbia Forest Professionals (ABCFP),
- Professional Engineer, registered with the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC)

I am responsible for the planning or design and field reviews required with respect to this crossing project. I have taken the appropriate steps as required under the Legislation for my profession, the *Guidelines for Professional Services in the Forest Sector - Crossings* and by good practice in order to sign and seal this Statement.

“Field review”, for the purposes of this statement, means such reviews of the work at the project site (and/or at the fabrication locations, if/as applicable) considered necessary, in my professional opinion, to ascertain whether or not the significant aspects of the work are considered to be in general conformance with the plans and supporting documents for this project.

Based on the results of the field reviews, I hereby give my assurance* that, in my professional opinion, the significant aspects of the construction work, generally conform with the plans and supporting documents for this project, including all revisions.

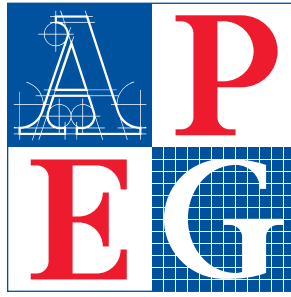
Significant revisions to the plans and supporting documents have been documented and marked on the plans or described in documents, and have been noted on the as-built plans and documents.

| | | |
|--|--|---|
| SIGNATURE OF PROFESSIONAL ENGINEER OR REGISTERED PROFESSIONAL FORESTER | | (Affix professional seal or stamp here) |
| NAME OF Coordinating Registered Professional (please print) | Date Signed Y M D | |
| ADDRESS (please print) | | |
| Phone No. | Fax No. | |

(If the Professional Engineer or Registered Professional Forester is a member of a firm, complete the following:)

I am a member of the firm _____ and I sign this Statement on behalf of the firm.

*Assurance means that a Professional Engineer or Registered Professional Forester has undertaken the work, that in his or her professional judgment, is considered necessary to ascertain whether the significant aspects of the crossing project are in general conformance with the plans and supporting documents.



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