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To: Regional Management Team
Northern Interior Forest Region

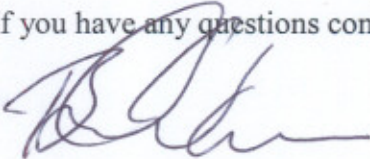
From: W.J. (Bill) Warner
Regional Executive Director
Northern Interior Forest Region

Re: Detailed Regional Engineering Cost Estimate (ECE) Procedures

As per Section 4.3.3 of the Interior Appraisal Manual, I have approved the attached procedures document to be used for generating, reviewing and approving detailed Engineering Cost Estimates (ECEs) for the Northern Interior Forest Region.

Copies will be distributed to forest industry association representatives from this office. Please distribute this document to all district staff involved in the review of appraisals. The document is effective as of July 1, 2006, and replaces the Interim procedures dated January 26, 2004.

If you have any questions contact John McClary, Revenue Manager at (250) 565-6216.


W.J. (Bill) Warner
Regional Executive Director
Northern Interior Forest Region

Attachment(s): 1

pc: Bill Howard, Director, Revenue Branch
Phil Zacharatos, Regional Executive Director, Southern Interior Forest Region
Tim Mergen, Past Chair, RNI ECE Procedures Working Group,
Mackenzie Forest District



DETAILED ENGINEERING COST ESTIMATE PROCEDURES

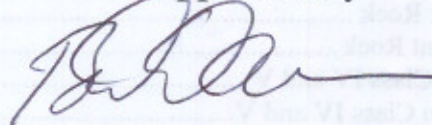
EFFECTIVE: July 1, 2006

NORTHERN INTERIOR FOREST REGION

INTERIOR APPRAISAL MANUAL (November 1, 2004)

**Prepared By
Northern Interior Forest Region Engineering Cost Estimate
Working Group**

Approved By



**Bill Warner, Regional Executive Director
Northern Interior Forest Region**

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A. ENGINEERED COST ESTIMATES – ADMINISTRATION PROCEDURES

A.1 AUTHORITY

Section 105 of the *Forest Act* authorizes the regional manager, regional appraisal co-ordinator and employees of the regional revenue section to determine stumpage rates in accordance with the policies and procedures approved for the forest region by the Minister of Forests and Range.

As outlined in the Interior Appraisal Manual (IAM) under section 4.3.3, the “regional manager may approve standardized procedures to generate cost estimates for use in projects” that qualify for a detailed engineering cost estimate (ECE).

A.2 BACKGROUND

The NIFR ECE Working Group was initiated following the merger of the Prince George and Prince Rupert Forest Regions into the Northern Interior Forest Region (NIFR). The mandate of the working group was to develop standardized procedures for the NIFR to replace the previously approved Prince George and Prince Rupert regional procedures.

Development of these standardized procedures was intended to reduce workload and provide consistency associated with the preparation, submission and review of detailed ECEs.

A.3 PURPOSE

The purpose of the Detailed Engineering Cost Estimates Procedures (Procedures) is to identify the requirements for submission and review of all detailed ECEs in the Northern Interior Forest Region (NIFR). The Procedures are intended to provide for the efficient and consistent application of the IAM throughout the NIFR.

A.4 DISCREPANCIES BETWEEN THE INTERIOR APPRAISAL MANUAL AND THE DETAILED ENGINEERING COST ESTIMATES PROCEDURES

When a discrepancy in interpretation is identified between the IAM and the Procedures, the IAM will prevail. The Regional Timber Pricing Co-ordinator will provide an interpretation in these situations.

A.5 ROLES AND RESPONSIBILITIES OF LICENSEE AND MOFR STAFF

Licensees and BCTS staff will:

- Ensure their ECE submissions are accurate, complete, and timely, and that submissions meet the standards established by the Procedures.

District staff will:

- Verify the ECE qualifies under the Procedures, and the IAM;

- Confirm the ECE data submitted meets the standards in the Procedures;
- Confirm site conditions and productivity estimates in the field or against local knowledge of the district; and
- Ensure costs are reasonable for the site conditions.

Timber Pricing Officers will:

- Clarify interpretations regarding the eligibility of specific ECE projects;
- Ensure data submitted meets the standards in the Procedures; and
- Verify the calculations submitted.

Regional Engineering Staff, when requested by District and/or Regional Timber Pricing Staff, will:

- Provide advice on engineering practices, site conditions, productivities, or specific engineering projects;
- Assist in updating cost tables in the Procedures, as information becomes available; and
- Provide support to district engineering staff when professional work is prescribed.
- Provide support to Timber Pricing Co-ordinator for management of lists for complex and special structures.

Timber Pricing Co-ordinator will:

- Provide an interpretation where discrepancies are identified between the Procedures and the IAM;
- Manage lists for supplemental equipment rates, special structures, and complex structures;
- Where a disagreement exists, provide an interpretation on application of the least cost principle for determining a rate; and
- Where required by changes to the Interior Appraisal Manual, recommend changes to the NIFR ECE Procedures to the Regional Manager.

A.6 APPLICATION OF LEAST COST APPRAISAL PRINCIPLE TO ECES

Section 4.1 of the IAM states, “the timber pricing co-ordinator must estimate development, harvesting and transportation costs for a cutting authority area using the information that the timber pricing co-ordinator has at the time the estimate is made in a manner that will produce the least total development, harvesting and transportation cost estimate.”

Licensees should ensure the cost effectiveness of their road development projects. Where the MoFR requests clarification on a project based on the least cost principle, the licensee will provide a rationale for their project selection, including any mitigating reasons that may have implications on applying the least cost principle.

The least cost principle may apply to the selection of a particular structure, a construction method or an individual piece of equipment. Prior to determination of a stumpage rate, the final interpretation on the application of the least cost option falls upon the Regional Timber Pricing Co-ordinator.

A.7 60 DAY NOTIFICATION

Section 4.3.3 of the IAM states, “Where specific development projects involve detailed engineering cost estimates, the district manager shall be advised of project details no later than 60 days before the start of work on the project.” The purpose of the 60-day notification is to allow district staff the opportunity to review the site and the engineering information provided in advance of ground disturbance or modification to the site. This requirement is separate from any approval process that authorizes construction.

Project details are defined as a written description of the works sufficient for the MoFR to evaluate whether the project qualifies as a detailed ECE. Detailed submission requirements identified under Items 1 through 13, and related cost estimates are not required until the time of the appraisal, although licensees are encouraged to submit this detailed information for approval in advance.

It is anticipated that 60 days will normally be sufficient to review the project details for determining eligibility of the project.

A.8 ENGINEERED COST ESTIMATES AND CHANGED SITE CONDITIONS

At the time of a reappraisal section 2.3.2(3) permits a re-estimation of the ECE once after construction, based on a change in site conditions from the original ECE submission. The revised ECE replaces the original ECE described in section 4.3.3 of the IAM.

When a change in site conditions occurs the licensee will immediately advise the district manager, in writing, of the change in site conditions. The MoFR will review the request, including the revised ECE(s), and determine if a changed circumstances reappraisal is allowed.

Submission of a revised ECE due to changed site conditions does not necessarily trigger a changed circumstances reappraisal. Section 2.3.2.1 of the IAM identifies when a changed circumstances will triggers a reappraisal.

A.9 TABULAR AND ECE SECTIONS

A road section costed as a detailed ECE can not be appraised as tabular road. Licensees must ensure that the total length of road in an appraisal, comprised of both tabular and ECE sections, does not exceed the total mapped or surveyed length. This does not apply to an ECE for structures or the replacement of road running surface.

Section length for subgrade construction is defined under Section 4.3.2.2(1) of the IAM. Section lengths must be a minimum of 0.1 km, which is a minimum of 100 meters. This applies to both tabular and ECE sections. Tabular sections greater than 100 meters are

rounded to the nearest 0.1 km; however, ECE sections greater than 100 meters will be taken as the actual length.

A.10 DEVELOPMENT COST ALLOCATION

The IAM requires that development works be allocated to the first tributary cutting authority. Where additional works as per section 4.3.1(2) of the IAM are required and were unknown at the time of the original appraisal, the cost estimate will be applied to the first tributary cutting authority appraised over the reconstruction or replacement. Where additional works were known at the time of the original appraisal, and the cost estimate was not applied to the first tributary cutting authority, the cost estimate is not eligible.

B. SUBMISSION STANDARDS

B.1 METHODS FOR DETERMINING DETAILED ENGINEERING COST ESTIMATES

There are three (3) methods for determining ECEs:

1. Public Tendering,
2. Regional Cost Tables, and
3. Detailed Calculations.

Where regional cost tables are available, but the licensee elects to estimate a project using detailed calculations, the licensee must demonstrate that the site conditions are outside of the norm.

For each project, the licensee may use only one of the above methods to estimate the cost. For example, if the licensee uses the cost table method, then all phase costs will be taken from the appropriate tables.

B.1.1 Public Tenders (Arm's Length Competitive Bids)

The licensee has the option of submitting the results of a public tender as an ECE for a specific project. Licensees may be required to show the process used to tender the project.

B.1.2 Regional Cost Tables

Regional Cost Tables represent average unit costs that may be either higher or lower than actual costs. Where Regional Cost Tables are available, the MoFR will accept an ECE derived from the cost tables without determining whether a detailed calculation would have resulted in a lower ECE. When reviewing ECEs derived from cost tables, MoFR staff will verify volume calculations, distance measurements, arithmetic and other applicable cost table variables.

B.1.3 Detailed Calculations

Where the licensee demonstrates that site conditions or the physical works are not represented by the cost tables, or where cost tables are not provided for the specific project, the ECE may be derived using detailed calculations.

Providing the specific cost items within a detailed ECE are eligible for inclusion, and the ministry estimate is within ten percent (10%) of the licensee's allowable total ECE, the allowable ECE will be accepted and used in the appraisal.

B.1.4 Surfacing Costs

Where the ECE project includes surfacing of the subgrade, the cost estimate for surfacing may be derived from any one of the following:

- Detailed estimate which is volume based,
- Formulas contained in the IAM (section 4.3.2.5), or
- Tendered contract.

B.2 GENERAL ECE SUBMISSION REQUIREMENTS

There are general submission requirements for all ECEs, regardless of the item or the method for determining the ECE. More detailed submission requirements are included with each ECE item. All required information must be submitted with the ECE to be accepted for review.

The following general submission requirements must be submitted with each ECE project:

- A project summary containing:
 - ◆ ECE Item (section 4.3.3) under which the project qualifies,
 - ◆ ECE project identified by road name or number, location, and crossing names for structures,
 - ◆ Submission date,
 - ◆ Related cutting authority (cutting permit and/or road permit), if available,
 - ◆ Cost summary by phase including unit costs and quantities,
 - ◆ ECE cost base year and trend factors used,
 - ◆ Licensee representative name and signature,
 - ◆ District and timber pricing officer signature blocks.
- ECE project location identified on map if required to support ECE project,
- Equipment used, rates, hours, and productivities by project phase,
- Labour hours and rates by project phase,
- List of materials, purchase cost, freight, applicable taxes, with volume calculations and productivity factors clearly indicated, and
- Professional prescriptions if prepared.

B.3 PRE-APPROVAL OF ENGINEERING COST ESTIMATES

ECEs may be submitted and reviewed by district MoFR staff in advance of the cutting authority appraisal being submitted. Regional timber pricing staff review ECEs submitted by the district.

If approved by regional timber pricing staff, district MoFR staff will provide the licensee with a copy of the approved ECE. The ECE amount (trended to the appropriate cost base year) will be included in a future appraisal. Licensees remain responsible for submitting the approved ECE with the applicable appraisal(s).

B.4 TRENDING ENGINEERING COST ESTIMATES

Section 4.3.3.1 of the IAM requires that “all detailed engineering costs must be adjusted to match the cost base of the manual in effect at the time of the appraisal or reappraisal.”

ECE submissions must therefore specify the cost base year for each phase cost estimated, and the trend factors used to bring each phase to a common cost base year. At the time of the first appraisal, and if reappraised, the ECE total will be trended accordingly. Table 4-5 of the IAM (Section 4.3.3.1) identifies the trend factors for ECE costs.

Where tendered contract values are used for the ECE, the value of the contract will be trended to the applicable cost base year.

ITEM 1: NEW CONSTRUCTION OF LONG TERM, PRIMARY ACCESS ROADS

1.0 Statement

New construction of long term, primary access road sections, that will have 300,000 cubic metres of harvested crown timber hauled over them annually for at least ten years.

1.1 Definition

This section applies to new construction only where the proponent has clearly demonstrated to the district that the access road meets the volume requirement for long-term access. Several proponents may be included in determining the volume of Crown timber to be transported across the proposed section.

1.2 Application

This ECE item was established to recognize the costs of construction for long-term operational roads that are not well defined by the operational road type included in section 4.3.2.2 of the IAM.

1.3 Submission Requirements

The proponent will provide the following data to support the ECE:

- Geometric road design, including plans, profiles and cross-sections. The design must identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types;
- Volume calculations, by soil type, and mass haul diagrams;
- Summary report for all drainage structures applicable to Item 1 – list of drainage structures (i.e. bridges, culverts);
- Locations of borrow pits, gravel pits, rock quarries and/or waste areas;
- Construction equipment to be employed; and
- Professional assessments and/or reports where they form part of the design and/or the foundation for the ECE.

1.4 ECE Determination

The ECE may be determined by either a detailed ECE calculation or through a public tender as outlined in Section B.1 of the Procedures. The ECE will be volume based (bank m³) and the volume calculations based on the geometric road design submitted with the ECE.

The ECE is not constrained by IAM tabular values and may contain all phases of construction, including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. Right of way logging activities (section 4.4 of the IAM) and road management activities (section 4.6 of the IAM) do not form part of the ECE.

**ITEM 2:
ROAD CONSTRUCTION ON UPHILL SIDE SLOPE GREATER THAN 50%**

2.0 Statement

Road construction on uphill side slopes greater than 50 percent.

2.1 Definition

The IAM defines the uphill side slope for both ECE and tabular sections as:

The average of the uphill side slopes in the given section. To derive an average for uphill side slope percent, several representative cross-section measurements are taken along the section length and the sum of one-half of the distance on each side of the measurement is applied as a weight against the measurement at that cross-section. The uphill side slope percent is measured at right angles to the road centerline and is recorded to the nearest integer. Where the road is located on a bench, the uphill side slope of the bench is used.

This ECE item is defined by the following:

1. The uphill side slope will be taken from measurements at cross-sections along the section length; and
2. The cross-sections must be greater than 50 percent to qualify for inclusion in the ECE section length.

2.2 Application

Slope percent for an ECE road section is calculated by the formula:

$$\text{Percent (\%)} = \frac{[X_1(10 + 0.5d_1) + X_2(0.5d_1 + 0.5d_2) + \dots + X_{(n-1)}(0.5d_{(n-1)} + 0.5d_n) + X_n(0.5d_n + 10)]}{D}$$

Where:

D is the ECE road section length

d is the distance between cross-sections

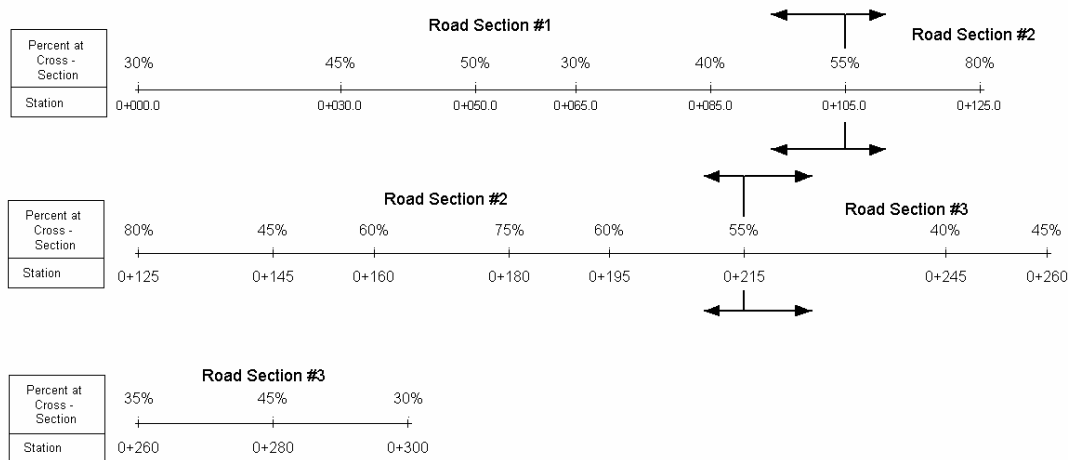
d₁ is the distance from the first cross-section to the next

X is the slope % at each cross-section along the road

X₁ is the slope % at the first qualifying cross-section.

As shown in Figure 2-1, the section length will be comprised of only those cross-sections that meet the slope criteria. The start and end of the ECE section is half the distance to the preceding or following cross-section to a maximum of 10 metres. This is based on an industry standard of a maximum spacing of 20 metres between cross-sections in rock or steep terrain.

Figure 2-1. Example for determination of qualifying cross-sections for uphill side slope.



In Figure 2-1, the ECE section starts at 0+095 and ends at 0+225. The tabular road sections include from 0+000 to 0+095, and from 0+225 to 0+300. The following sample calculation calculates the average side slope percent for the qualifying road section (Road Section #2).

Example Calculation of Side Slope Percent (%) for Road Section #2

$$\begin{aligned}
 &= [55\% (10 + 0.5*20) + 80\% (0.5*20+0.5*20) + 50\% (0.5*20+0.5*15) + \\
 &\quad 60\% (0.5*15+0.5*20) + 75\% (0.5*15+0.5*15) + 60\% (0.5*15+0.5*20) \\
 &\quad + 55\% (0.5*20 + 10)] \div 130 \\
 &= [55\% (20m) + 80\% (20m) + 50\% (17.5m) + 60\% (17.5m) + 75\%(15m) + 60\% \\
 &\quad (17.5m) + 55\% (20m)] \div 130m \\
 &= 7900\% m \div 110m \\
 &= 61\%
 \end{aligned}$$

2.3 Submission Requirements

The proponent will provide the following information to support the ECE:

- Geometric road design including plans, profiles and cross-sections. The design must identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types for the entire road length proposed as an ECE;
- Volume calculations, by soil type ;
- Summary report for all drainage structures;
- Location of borrow pits, gravel pits, rock quarries and/or waste sites;
- Professional assessments and/or reports where they form part of the design and/or the foundation for the ECE;
- Construction equipment to be employed; and
- Section lengths showing the calculated uphill side slope percent.

In steep terrain, cross-sections must identify the various grade breaks for road design. The uphill side slope will be determined from the geometric road design.

2.4 ECE Determination

The ECE may be a detailed cost estimate or the result of a public tender, as outlined in Section B.1 of the Procedures. The ECE will be based on the volumes (bank m³) included in the geometric road design submitted with the ECE.

The ECE is not constrained by IAM tabular values and may contain all phases of construction, including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. Right of way logging activities (section 4.4 of the IAM) and road management activities (section 4.6 of the IAM) do not form part of the ECE.

**ITEM 3:
ROAD CONSTRUCTION WHERE ROCK PERCENT EXCEEDS 50%
OR TERRAIN CLASS IV OR V**

3.0 Statement

When rock percent exceeds 50 percent, or terrain class 4 and 5.

3.1 Definition for Percent Rock

The IAM defines percent rock as:

Bedrock and large boulders (each greater than 1.5 m in diameter). It may be rippable or may require drilling and blasting. To derive an average for rock percent, several representative cross-section measurements are taken along the section length and the percent rock calculated. The sum of one-half of the distance on each side of the measurements where taken is applied as a weight against the percent rock calculated at that cross-section. The percent rock is determined as follows:

$$\text{Rock\%} = \frac{h^2}{H^2} * 100$$

Where:

h = the vertical cut height of all rock measured from the bottom of the ditch

H = the total vertical cut height of all materials above the bottom of the ditch

To determine the percent rock for roads not yet constructed, constructed roads on similar land/rock forms are used as a guide. Alternatively, where estimates of rock volume from commercial road design programs are available for tabular sections, that information may be used to estimate the rock percent.

Height or depth of rock may be determined by:

- estimating the overburden depth (requires visible surface rock);
- using adjacent roads constructed in similar materials; or
- digging soil pits and/or examining blowdown to determine the depth of overburden materials.

Figures 3-1 and 3-2 illustrate how to measure h and H and the calculation of Percent Rock. As shown in the figures, the total vertical cut height is measured from the bottom of the ditch to the top of the natural ground line.

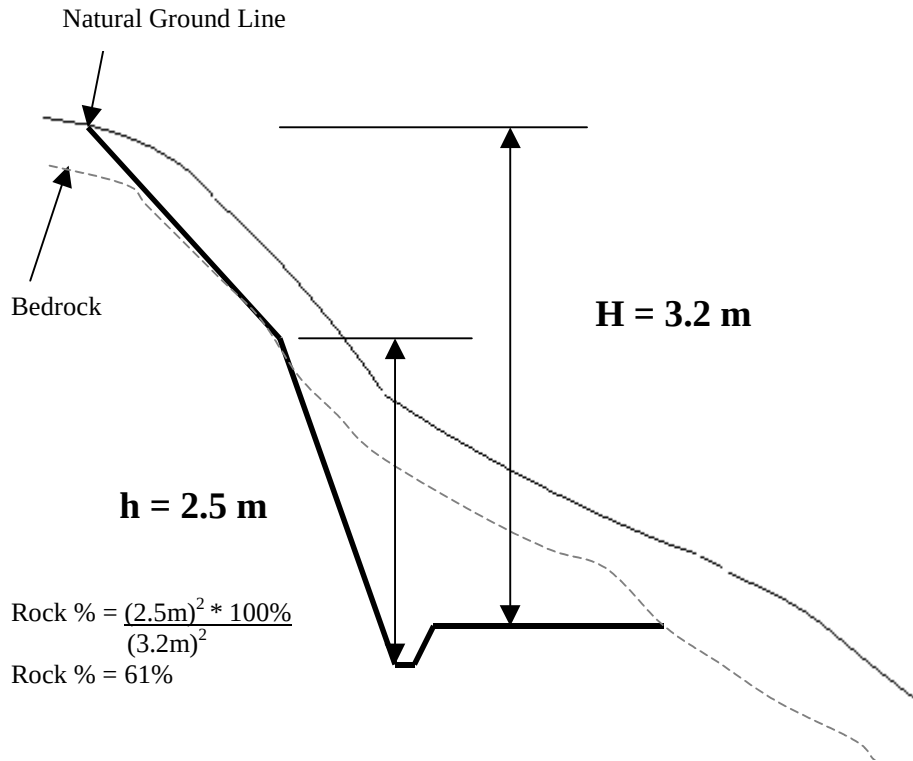


Figure 3-1. Sample Cross-Section where Rock Percent exceeds 50%.

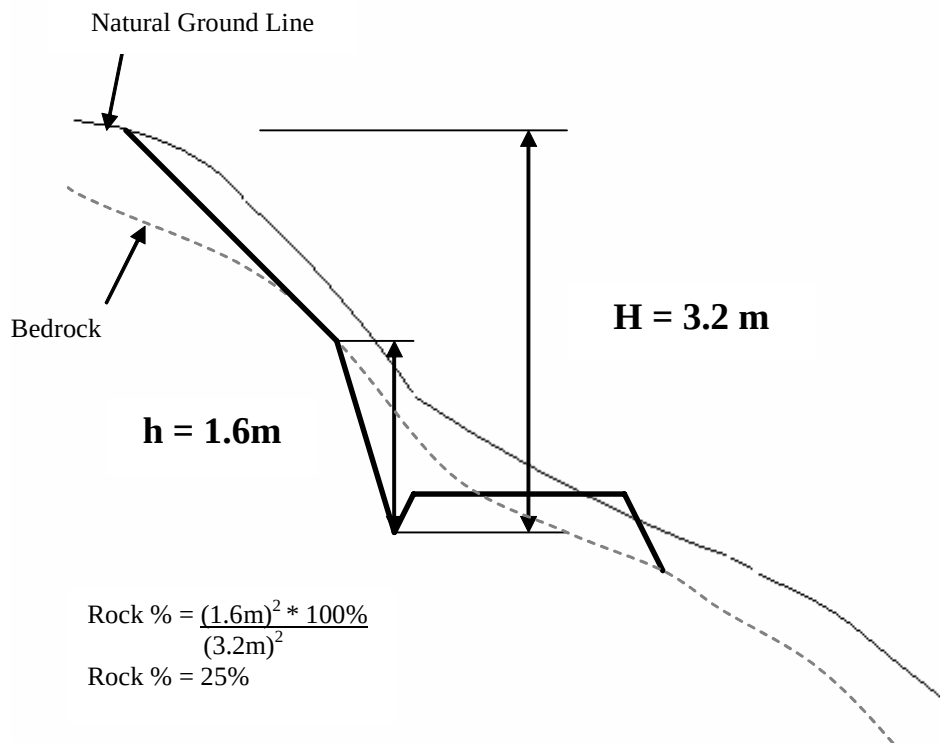


Figure 3-2. Sample Cross-Section where Rock Percent is less than 50%.

3.2 Application for Percent Rock

Rock percent for a road section is calculated by the formula:

$$\text{Percent (\%)} = \frac{[X_1 (10 + 0.5d_1) + X_2 (0.5d_1 + 0.5d_2) + \dots + X_{(n-1)} (0.5d_{(n-1)} + 0.5d_n) + X_n (0.5d_n + 10)]}{D}$$

Where:

D is the ECE road section length

d is the distance between cross-sections

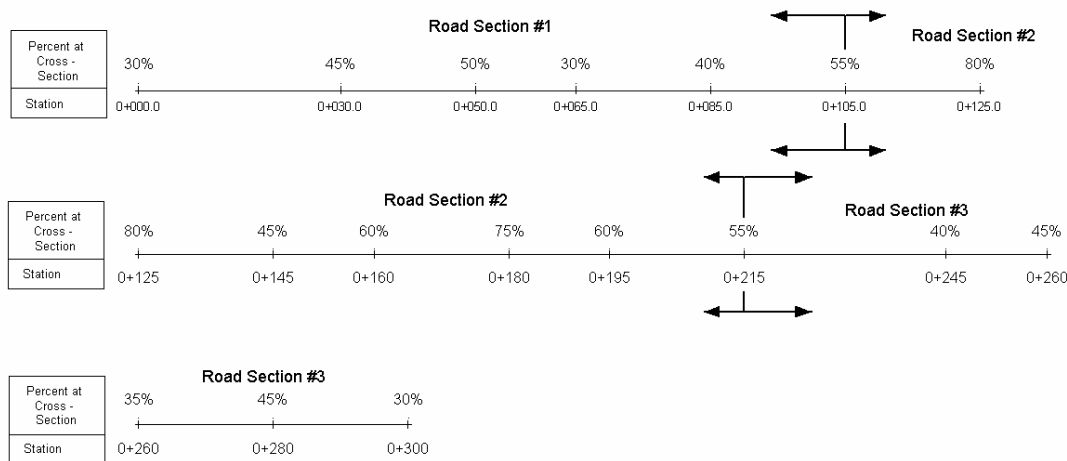
d₁ is the distance from the first cross-section to the next

X is the rock % at each cross-section along the road

X₁ is the rock % at the first qualifying cross-section.

As shown in Figure 3-3, the section length will be comprised of only those cross-sections that meet the slope criteria. The start and end of the ECE section is half the distance to the preceding or following cross-section to a maximum of 10 metres. This is based on an industry standard of a maximum spacing of 20 metres between cross-sections in rock or steep terrain.

Figure 3-3. Example for determination of qualifying cross-sections for rock percent.



In Figure 3-3, the ECE section starts at 0+095 and ends at 0+225. The tabular road sections include from 0+000 to 0+095, and from 0+225 to 0+300. The following sample calculation calculates the average side slope percent for the qualifying road section (Road Section #2).

As the ditch depth may impact whether a section qualifies for an ECE, the ditch depth used to calculate rock height should not exceed 500mm as measured from the top of sub-grade.

Example Calculation of Percent Rock (%) for Road Section #2

$$\begin{aligned} &= [55\% (10 + 0.5*20) + 80\% (0.5*20+0.5*20) + 50\% (0.5*20+0.5*15) + \\ &\quad 60\% (0.5*15+0.5*20) + 75\% (0.5*15+0.5*15) + 60\% (0.5*15+0.5*20) \\ &\quad + 55\% (0.5*20 +10)] \div 130 \\ &= [55\% (20m) + 80\% (20m) + 50\% (17.5m) + 60\% (17.5m) + 75\%(15m) + 60\% \\ &\quad (17.5m) + 55\% (20m)] \div 130m \\ &= 7900\% m \div 110m \\ &= 61\% \end{aligned}$$

3.3 Definition of Terrain Class IV and V

An interpretation of Terrain Class IV and V is provided in *Land Management Handbook Number 18* (Chatwin et. al., 1994).

Class IV terrain is:

- Expected to contain areas with a moderate to high likelihood of slope failures following conventional road construction. Wet season construction will significantly increase the potential for slope failure; or
- Where there is a moderate likelihood of slope failure in logged areas.

Class V terrain is:

- Where there is a high likelihood that slope failure will follow logging or conventional road building.

3.4 Application of Terrain Class IV and V

This section will apply to road construction within Terrain Class IV and/or V terrain as determined through a Terrain Stability Field Assessment. The assessment should recommend site-specific actions to mitigate the landslide hazards and risks resulting from the road construction or development.

From the assessment, a prescription should be completed that outlines specific design requirements for the geometric road design. The prescription may outline that road construction be possible with normal construction techniques, or may place restrictions on the time of year when construction can occur. It may also require the end hauling of material

to avoid sidecasting, the use of geotechnical materials, the construction of earth retention systems, or other special structures.

3.5 Submission Requirements for Rock Percent and Terrain Class IV and V

The proponent will provide the following information to support an ECE for either Rock Percent or Terrain Class IV and V:

- Geometric road design including plans, profiles and cross-sections. The design must identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types;
- Volume calculations, by soil type;
- Location of borrow pits, gravel pits, rock quarries and/or waste sites;
- Construction equipment to be employed;
- For Rock Percent ECEs, the section lengths showing the calculated Rock Percent; and
- For Terrain Class IV and V, professional terrain stability assessment which clearly outlines the limits of the Class IV and V terrain with respect to road construction;
- For Terrain Class ECEs, the prescription outlining the measures to maintain slope stability for the road section.

3.6 ECE Determination for Rock Percent greater than 50%

The ECE may be a detailed cost estimate or the result of a public tender as outlined in Section B.1 of the Procedures. The ECE will be based on the volumes (bank m³) included in the geometric road design.

The ECE is not constrained by IAM tabular values and may contain all phases of construction, including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. Right of way logging activities (section 4.4 of the IAM) and road management activities (section 4.6 of the IAM) do not form part of the ECE.

Table 3-1 is to be used to estimate the cost for rock ripping, drilling and blasting based on the bank volume of rock per lineal metre of road constructed as indicated in the geometric road design. The unit costs in Table 3-1 cover all equipment, material and labour costs associated with ripping, drilling and/or blasting of rock, including mobilization and demobilization of specialized equipment. The costs do not include those associated with excavation of the rock, building the sub-grade, or stabilizing the road surface.

Where the licensee demonstrates the cost tables do not represent the site conditions, a detailed ECE for rock ripping, drilling and blasting may be submitted.

Table 3-1. Rock Ripping, Drilling and Blasting Costs based on Rock Volume per lineal meter of road construction.

<i>Rock Ripping, Drilling and Blasting Cost (\$/bm³) All-found Cost 2001 Cost Base</i>	
<u>Rock Volume (bm³/lm)</u>	<u>Rate/Volume</u>
14.0- >	\$ 5.18
9.5-13.9	\$ 5.70
4.5-9.4	\$ 6.22
2.5-4.4	\$ 6.73
1.0-2.4	\$ 7.77
0.5-0.9	\$ 8.81
0-0.49	\$ 9.84

3.7 ECE Determination for Terrain Class IV or V

The ECE may be a detailed cost estimate or the result of a public tender as outlined in Section B.1 of the Procedures. The ECE will be based on the volumes (bank m³) included in the geometric road design.

The ECE is not constrained by IAM tabular values and may contain all phases of construction, including road survey, layout and design, grubbing and stripping, subgrade construction, drainage construction and surfacing. Right of way logging activities (section 4.4 of the IAM) and road management activities (section 4.6 of the IAM) do not form part of the ECE.

Costs for terrain stability assessments are considered overhead under section 4.8 of the IAM; however, the cost for geotechnical surveys, including preparation of the prescription and/or design, may be submitted with the ECE. Costs for supervision by a professional engineer are limited to those road construction projects that have been deemed as complex and are pre-approved by the regional timber pricing co-ordinator.

ITEM 4: END HAUL CONSTRUCTION

4.0 Statement

End haul construction (of roads and landings) requiring removal by truck of excavated material to a separate area to avoid side casting on steep and/or sensitive sites.

4.1 Definition

This item is defined by all three of the following parameters:

1. Requirement for the road to be constructed by trucking out the material from the road/landing cut;
2. Requirement to haul the excavated material to a separate area from the end haul road section; and
3. Requirement to avoid side casting on steep and/or sensitive sites within the section length.

4.2 Application

End haul construction typically occurs on steep terrain in excess of 60%, but can occur on slopes of lower relief where the material types are not suitable for sidecast construction, where slopes may be unstable, or for the construction of earth retaining structures.

4.2.1 Exception

Where construction requires the excavation of materials and the removal of this material by truck, for the purpose of maintaining the percent grade, such as a through cut, this construction is considered to be within the definition of the IAM tabular cost estimate method (unless qualifying in another ECE category).

4.3 Submission Requirements

No end haul construction will be accepted for an engineering cost estimate without the accompaniment of appropriate supporting data to evaluate the cost estimate.

The proponent will provide the following information to support an ECE for end haul construction:

- Geometric road design, including plans, profiles and cross-sections. The design must identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types;
- Volume calculations, by soil type, and mass haul diagrams;
- Average road grade to the designated spoil area(s); and
- Professional assessments and/or reports where they form part of the design and/or the foundation for the ECE.

4.4 ECE Determination

The ECE for end haul construction may use any of the three approved methods for preparing an ECE as outlined in Section B.1 of the Procedures. All estimates will be volume based, and plans should indicate the bank m³ to be moved and distance to the spoil area used. End haul material should be utilized as road fill wherever feasible.

All phase construction costs, including costs for road survey and design, can be included in the detailed ECE, with the exception of right of way logging costs. The cost tables include allowances for all construction costs except culverts and road survey and design.

Tables 4-1 and 4-3 are to be used for end haul construction in rock, and Table 4-2 for construction in OM. The unit costs contained in Tables 4-1 and 4-2 represent an all found rate for loading, hauling and wasting of excavated material and the construction of a finished subgrade in the ECE road section. The unit cost for steep road grades assumes articulated rock trucks are used. In rock construction, Table 4-3 is used to estimate the cost of ripping or drilling and blasting in conjunction with Table 4-1.

Culverts costs are not included in Tables 4-1 or 4-2. Culvert costs are to be estimated using Table 8-1 and incorporated into the end haul project estimate.

Since cost tables are available for end haul construction, the licensee must demonstrate that the site conditions are outside of the norm if they choose to estimate a project using detailed calculations.

Where material from an end hauling section is utilized for an adjacent overland section, Tables 4-1 and 4-2 may be used to estimate the loading, hauling and placing of the material from the end hauled section, and also the subgrade construction cost for both end hauled and overlanded sections. A separate cost estimate for the end hauled section is not appropriate, as the end hauled section should be combined with the overlanded section.

Table 4-1. End haul Construction Costs for Rock.

<i>End haul Construction Cost in Rock (\$/bm³) Load, Haul, Waste and Subgrade Construction 2001 Cost Base</i>				
	Haul Distance to Waste Area (km)			
Road Grade* (Average. %)	0 - 1	1 - 2	2 - 3	3 - 4
0 - 5	\$6.50	\$7.47	\$8.50	\$9.60
>5 - 10	\$7.80	\$8.97	\$10.05	\$11.15
>10 - 15	\$9.36	\$10.76	\$11.85	\$13.00
>15 - 20	\$11.23	\$12.91	\$14.15	\$15.20

*Road grade may be adverse or favourable. It is the average road grade from the midpoint of construction to the spoil area.

Table 4-2. End haul Construction Costs for Other Material (OM).

<i>End haul Construction Cost in OM (\$/bm³) Load, Haul, Waste and Subgrade Construction 2001 Cost Base</i>				
	Haul Distance to Waste Area (km)			
Road Grade* (Average. %)	0 - 1	1 - 2	2-3	3-4
0 - 5	\$5.50	\$6.47	\$7.50	\$8.60
>5 - 10	\$6.80	\$7.97	\$9.05	\$10.15
>10 - 15	\$8.36	\$9.76	\$10.85	\$12.00
>15 - 20	\$10.23	\$11.91	\$13.15	\$14.20

*Road grade may be adverse or favourable. It is the average road grade from the midpoint of construction to the spoil area.

Table 4-3. Rock Ripping, Drilling and Blasting Costs.

<i>Rock Ripping, Drilling and Blasting Cost (\$/bm³)</i> <i>2001 Cost Base</i>	
<u>Rock Volume (bm³/lm)</u>	<u>Rate/Volume</u>
14.0- >	\$ 5.18
9.5-13.9	\$ 5.70
4.5-9.4	\$ 6.22
2.5-4.4	\$ 6.73
1.0-2.4	\$ 7.77
0.5-0.9	\$ 8.81
0-0.49	\$ 9.84

ITEM 5: OVERLAND CONSTRUCTION

5.0 Statement

Overland construction to provide a roadbed by trucking in material for extensive filling; see page 81 of the Forest Road Engineering Guidebook for a more detailed description.

5.1 Definition

This item is defined by the following two parameters:

1. A requirement for the roadbed of fill material trucked into the site; and,
2. A requirement for extensive filling over natural, undisturbed thick organics and/or weak soils.

5.2 Application

Overland is a construction technique that typically occurs on low, flat, wet areas where the underlying weak mineral or thick organic soils will not provide stable support for the fill prism using conventional construction techniques.

The objective is to distribute vehicle loads over weak soils using the inherent strength of the vegetation mat to support the weight of the road fill without disturbing subsurface groundwater flows. Overlanding involves minimizing disturbance of the natural ground cover that may provide a significant amount of the required fill support while preventing the unsuitable soils below the vegetation mat from mixing with the imported subgrade material. Overlanding generally involves a minimum 50 cm (0.5 m) depth of trucked in material.

Ditching is not recommended for overlanded sections, unless the ditch is located a sufficient distance away from the road to prevent weakening of the vegetation mat underneath the road. Ditches should not be excavated to obtain the required road fill materials.

Overland construction techniques may include placing a layer of unmerchantable trees, logs, inverted stumps, roots or branches, otherwise known as corduroy or puncheon, perpendicular to the road centerline to form a mat for the road fill. The mat separates the road fill from the underlying soil and supports the fill.

The use of geosynthetics also provides a method for separating materials and reinforcing the subgrade where properly installed. For roads intended for short-term use, the use of geosynthetics (geotextiles and/or geogrids) during construction where organic materials are shallow may not be cost effective.

5.2.1 Exceptions

The ECE for overland construction requires material be trucked to the site. Road sections where the design includes a cut adjacent to an area of fill and these fill sections are within the average push range of crawler equipment, an ECE for overland construction is not

permitted in the 'pushed' section. The qualifying ECE section is to be reduced by the volume of cut material available within the maximum push distance as described below. Average crawler equipment push distances are defined as:

	<u>Low Chainage</u>	<u>High Chainage</u>
Rock:	40 meters	20 meters
OM:	80 meters	40 meters

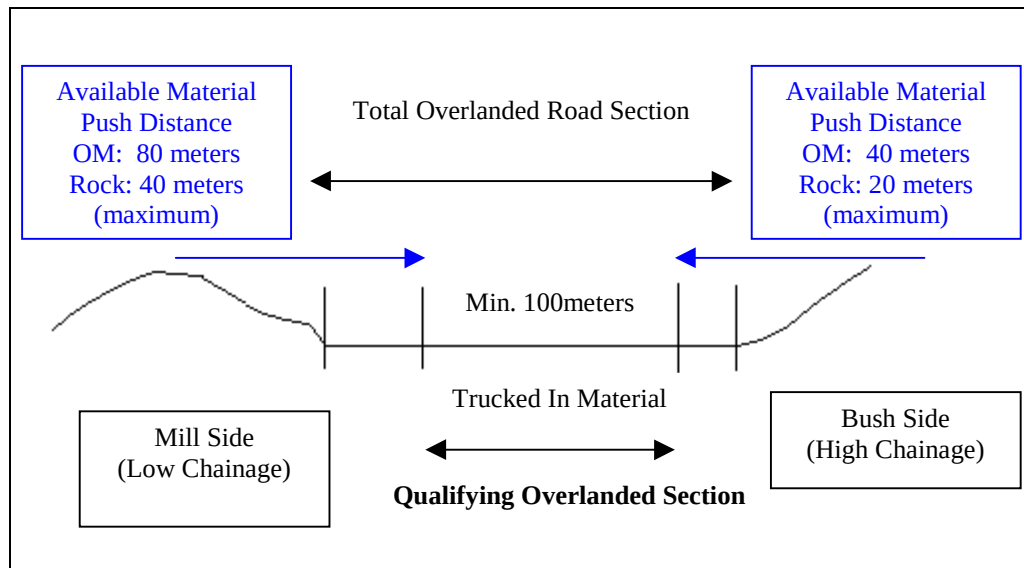


Figure 5-1. Overlanded road section showing removed 'pushed' sections and qualifying overlanded section.

An ECE for overland construction is not permitted where subgrade materials are obtained from the construction of ditches in the road section. Construction of this nature is described as normal sub-grade construction and not overland construction.

Overland construction does not apply to snow roads including when snow is imported to the site.

5.3 Submission Requirements

The proponent will provide the following information to support an ECE for overlanding:

- Geometric road design, including plans, profiles and cross-sections where required. The design must identify the ground profile, final grade lines, road width, drainage structures, cut and fill slopes and soil types for the entire road length proposed as an ECE;
- Volume calculations and mass haul diagram indicating any push of material from adjacent road sections;
- A description of the underlying soil types to justify the use of overlanding, and
- The location of the designated borrow site(s).

5.4 ECE Determination

The ECE for overland construction may use any of the three approved methods for preparing an ECE as outlined in Section B.1 of the Procedures. All estimates will be volume based, and plans should indicate the bank m³ to be moved and distance to and from the borrow site.

All phase construction costs can be included in the detailed ECE, with the exception of right of way logging costs. An ECE for overland construction may include costs for the following:

- Production of a geometric road design, including plans, profiles and cross-sections,
- Supply, transportation (truck), placement, spreading and compaction of fill material,
- Supply, transportation and installation of geotextiles or geogrids,
- Installation of corduroy, puncheon and/or brush mats,
- Supply and installation of any culverts, if required, and
- Surfacing, if required and allowable.

Where the proponent proposes to utilize quarried rock for the fill material, the proponent must provide sufficient information to determine that the use of quarried material represents the least cost compared to importing OM fill.

Where the proponent prepares an ECE using the cost tables, Table 5-1 is to be used for the construction of block roads, and Table 5-2 for the construction of operational roads. The lineal meter cost is applied to the exact length of the qualifying ECE section, which must be specified. The definition of road types, block and operational, are outlined in section 4.3.2.2 of the IAM.

The unit costs in Tables 5-1 and 5-2 represent all-found costs for complete subgrade for overland construction including all equipment, labour and material costs.

Tables 5-1 and 5-2 do not include allowances for surfacing the subgrade. Where fill materials are considered suitable as surfacing material, no additional allowance for road surfacing is to be included with the ECE. If the fill material is not suitable as road surface material, an ECE for road surfacing may be considered.

Where the development of a rock quarry to produce rock for fill is deemed to be least cost method, quarry development costs in Table 5-3 may be included in the ECE with the overland construction costs in Tables 5-1 and 5-2.

OVERLAND CONSTRUCTION COST TABLES

Table 5-1. Overland Construction for Block Roads.

Overland Construction Cost for Block Roads* (\$/lineal meter) All-found Construction Cost (2001 cost base)			
<u>Haul Distance from Fill Source to Midpoint of Overlanded Section (km)</u>			
0-1.0	1.0-2.0	2.0-3.0	3.0-4.0
\$33.00/l-m	\$36.50/l-m	\$40.00/l-m	\$43.50/l-m

*As defined by IAM Section 4.3.2.2.

Table 5-2. Overland Construction for Operational Roads.

Overland Construction Cost for Operational Roads* (\$/lineal meter) All-found Construction Cost (2001 cost base)			
<u>Haul Distance from Fill Source to Midpoint of Overlanded Section (km)</u>			
0 - 1.0	1.0 - 2.0	2.0 - 3.0	3.0 - 4.0
\$50.00/l-m	\$57.00/l-m	\$65.00/l-m	\$72.00/l-m

*As defined by IAM Section 4.3.2.2.

Table 5-3. Quarry Development Costs.

Quarry Development Costs (\$/bm ³) All found cost for Site Prep, Drill and Blast* 2001 Cost Base	
<u>Volume (bm³)</u>	<u>Unit Cost</u>
≥ 1000m³	\$ 7.00
< 1000m³	\$ 7.00

* Includes grubbing, access costs for drill, all supplies, equipment and labour.

Where material for the overlanding section is obtained from an adjacent end haul section, Tables 5-4 and 5-5 may be used to estimate the loading, hauling and placing of the material from the end hauled section, and also the subgrade construction cost for both end hauled and overlanded sections. The unit cost derived from either Table 5-4 or Table 5-5 is applied against the bank m³ in the end haul section. A separate cost estimate for the end hauled section is not appropriate, as the end hauled section should be combined with the overlanded section.

Table 5-4. Combined End haul and Overland Construction Cost in Rock (\$/bm³).

<i>End haul and Overland Construction Cost in Rock (\$/bm³) Load, Haul to Overland, and Subgrade Construction 2001 Cost Base</i>				
	Haul Distance to Overland Section (km)			
Road Grade (Avg. %)	0 - 1	1 - 2	2 - 3	3 - 4
0 - 5	\$6.50	\$7.47	\$8.50	\$9.60
5 - 10	\$7.80	\$8.97	\$10.05	\$11.15
10 - 15	\$9.36	\$10.76	\$11.85	\$13.00
15 - 20	\$11.23	\$12.91	\$14.15	\$15.20

Table 5-5. Combined End haul and Overland Construction Cost in OM (\$/bm³).

<i>End haul and Overland Construction Cost in OM (\$/bm³) Load, Haul to Overland, and Subgrade Construction 2001 Cost Base</i>				
	Haul Distance to Overland Section (km)			
Road Grade (Avg. %)	0 - 1	1 - 2	2 - 3	3 - 4
0 - 5	\$5.50	\$6.47	\$7.50	\$8.60
5 - 10	\$6.80	\$7.97	\$9.05	\$10.15
10 - 15	\$8.36	\$9.76	\$10.85	\$12.00
15 - 20	\$10.23	\$11.91	\$13.15	\$14.20

**ITEM 6:
LOG AND NON-LOG BRIDGES
(NOT INCLUDED IN SUBGRADE COST ESTIMATES)**

6.0 Statement

For log bridges and non-log bridges that are not included in the sub-grade cost estimates, eligible costs include site planning and the same phases as listed in Section 4.3.2.4 (2) of the IAM. All ice bridge construction including construction for additional logging seasons.

6.1 Definition

This item applies to all bridges that are not included in the subgrade construction cost estimate outlined in section 4.3.2.1 of the IAM.

6.1.1 Exceptions

Single log abutment culverts with span lengths up to and including 3.4 meters are included in the subgrade construction cost estimate, and as such, do not qualify for an ECE.

6.2 Application

The supply and installation of new structures and the re-installation of a superstructure at a new site are both covered under this ECE item. The bridge structure type and span for a new structure should be based on the intended life span and designed road standard.

The removal for the purposes of re-installation of superstructure and substructure components is outlined under this ECE item. These costs are applied when the structure is being proposed for re-installation at a new site, and not with the previous installation. This is not considered deactivation but removal and transportation to the new installation site.

The construction of wood box culverts is also outlined in this ECE section as they are treated as log bridge structures.

6.2.1 Bridge Definitions

The following definitions are applicable to ECE for bridges:

Temporary Bridge: Bridge structure that has a planned installation period of less than 15 years.

Permanent Bridge: Bridge structure that has a planned installation period of at least 15 years.

Seasonal Bridge: Bridge structure installed for less than 1 year and generally not designed to pass a Q100 flood event. Includes bridges built with snow fills, or on mud sills, single log sills or log bundles.

Portable Bridges: Bridge superstructure designed and fabricated to be reinstalled more than once, and may be used in either temporary or permanent installations.

Work Bridge: Temporary crossing installed to allow for the movement of bridge construction equipment necessary to complete the installation of a temporary or permanent bridge. A work bridge is an acceptable cost item when bridge construction equipment must cross over the stream, and, the proponent shows that no in-stream crossing is feasible or permitted. This item is not allowed if installation of the structure occurs, or should occur, commensurate with road construction.

6.3 Submission Requirements

The proponent will submit the following information to support the engineered cost estimate:

- Riparian class of the stream (must indicate if it is a default classification);
- For the installation of all new superstructures or when tables are not used for a re-installation, a site plan which includes:
 - High water mark;
 - Stream velocity and direction;
 - Streambed materials;
 - Cross-sections at centreline and at intervals upstream and downstream;
 - Plan view and profile view of the watercourse; and
 - Date of survey.
- For all the installation of all new superstructures or when tables are not used for a re-installation, a general arrangement which includes:
 - Design span and abutment height;
 - Horizontal and vertical alignment of the bridge in relation to the stream;
 - Road centerline;
 - Bridge superstructure and substructure components;
 - Endfill volumes within 8 meters of the bridge;
 - Approach fill volumes to a maximum 15 meters on either end of the bridge;
 - Extents, volume and class of rip rap; and
 - Designer of Record and qualifications (P.Eng., R.P.F., or other).

The proponent will identify the design standard applied and where there is a requirement for a design to be prepared by a professional engineer, the proponent will supply a set of sealed design drawings with the ECE. Professional design costs will be accepted for the design of bridge structures where incurred.

6.3.1 Installation of previously used structures

All portable structures are required to be assigned a tracking number that is affixed to the structure at the time of initial installation. If known this tracking number will be reported and included with the ECE for a temporary installation.

6.4 ECE Determination

The ECE for bridge design, supply and installation may use any of the three approved methods for preparing an ECE as outlined in Section B.1 of the Procedures.

The cost tables apply to the installation of temporary and permanent single-span, steel girder bridges. Where multiple span, seasonal, pre-cast concrete, log stringer or other bridge configurations are proposed that are not covered by the cost tables, a detailed ECE must be submitted.

Costs for the following items may be included in an ECE for a bridge or wood box culvert:

- Production of a site plan and general arrangement,
- Production of structural design drawings for new structures only,
- Purchase cost of bridge superstructure (only for new structures),
- Purchase cost of bridge substructure and associated components,
- Transportation (freight) for materials,
- Mobilization and demobilization of specialized equipment,
- Site preparation,
- Superstructure installation,
- Substructure installation,
- Supply, placement and compaction of endfill (volumes as per design),
- Supply, placement and approach fills (maximum 15 meters each side),
- Supply and placement of rip rap or scour protection (volumes as per design),
- Supply and installation of fenders, delineators, hazard markers or required signage,
- Supervision by a Professional Engineer (complex structures only),
- Certification by a Professional Engineer,
- Installation and removal of a work bridge, where justified.

6.4.1 Bridge Rentals

The cost allowance for the rental of bridge superstructures will be based on the current purchase price of the structure over the average lifespan of the superstructure. For portable bridges, the average lifespan will be taken as 15 years for the steel superstructure, 8 years for an untreated wooden deck or deck module, and 15 years for a treated deck or deck module. This would apply to all proponents that have the ability to purchase and re-use a portable superstructure, but choose to rent a structure for other reasons.

The Regional Timber Pricing Officer may accept a higher or market based rental price if he/she determines it would not be cost effective to purchase and reuse a portable structure or other construction options do not exist.

6.5 Regional Cost Tables for Bridges and Wood Box Culverts

Tables 6-1 to 6-9 include all costs associated with the construction of temporary and permanent single-span bridges. The tables do not apply to bridges installed that meet the

definition of seasonal. A total installation cost is determined by summing the values from those tables appropriate to the design.

Tables 6-1-A and 6-1-B outline the cost allowance for survey, site plan and design for installations. Table 6-1-A is to be used for new bridges only as it includes a cost allowance for structural design. For the re-installation of a previously installed superstructure, Table 6-1-B is to be used for the ECE.

Table 6-1-C is to be included in the ECE where a Professional Engineer will certify the bridge.

Tables 6-2-A and 6-2-B outlined the cost allowance for the supply of the superstructure for CL-625 and L100 design load bridges respectively. These costs are not to be interpolated, and standard rounding convention will be used for bridge length. For example, a structure of 12.2 meters overall length is rounded to 12.0 meters and a structure of 12.5 meters is rounded to 13.0 meters. Bridges in excess of 24.4 meters overall length require a full detailed ECE to be submitted.

Tables 6-3-A through 6-3-D include the cost allowances for the installation of a single abutment for four different types of foundations or substructures. The ECE should include a cost for each of the two abutments based on the design. A bridge design may include two different types or sizes of foundations, therefore, more than one of these tables may need to be applied. These costs include endfills and approach fills to a completed subgrade stage. No costs for gravel surfacing of bridge approaches will be allowed unless the bridge length, including 30 meters for approaches, is deducted from the tabular road section submitted in the appraisal.

Tables 6-4-A and 6-4-B include the cost allowance for the supply and installation of a bearing cap or bearing sill if required by the design.

Table 6-5 includes the cost allowance for the installation of the superstructure, which includes the girders, deck, curbs and rails.

Table 6-6 includes the cost allowance for the supply, installation and removal of a work bridge if justified for the site. A work bridge will not be permitted when the construction occurs, or should occur, commensurate with road construction. In that situation, the temporary crossing is considered part of the subgrade construction cost allowance. A work bridge will be considered where the licensee provides an adequate rationale based on regulatory requirements. The approved span for a work bridge will be based on the submitted site plan for the main crossing.

Tables 6-7 and 6-8 include the cost allowances for the removal of a portable bridge superstructure and interlocking pre-cast concrete blocks respectively. These costs may be applied to an ECE for the re-installation of these materials at a new site, and represent the costs for dismantling and transportation to the new installation site. These costs are not

considered deactivation, as they do not cover any rehabilitation costs at the old site and are only applied when the material is reused at another location.

Table 6-9 includes the additional cost allowed for mobilization and demobilization for sites that are greater than 250 kms from the identified Point of Appraisal or are not serviced by all-season roads. A detailed cost may be included with the table costs for these sites.

Cost allowances for the construction of Wood Box Culverts are included in Table 6-10 for spans from 3.5 to 15.4 meters and sill heights up to 2 meters. Structures outside of these dimensions will require a detailed ECE to be submitted.

REGIONAL COSTS TABLES FOR THE SURVEY, DESIGN AND CERTIFICATION OF BRIDGES TEMPORARY AND PERMANENT ONLY

Where a site specific detailed site plan is required or prepared.

Table 6-1-A. Survey, Site Plan and Design Cost for New Installations.

<i>Survey, Site Plan and Design Cost Estimate[*]</i> <i>New Permanent or New Temporary Bridges⁺</i> <i>2001 Cost Base</i>	
≤ 24 m	> 24 m
\$ 7,000	Submit detailed estimate

^{*} Includes all site specific professional and non-professional costs for survey, production of a site plan and general arrangement, and detailed design drawings for the bridge components (including detailed steel design).

⁺ Assumes the proponent is not using superstructure drawings previously developed for another site or for repeated use (i.e. standard drawings).

Table 6-1-B. Survey, Site Plan and Design Cost for Previously Installed Structures.

<i>Survey, Site Plan and Design Cost Estimate^{**}</i> <i>Previously Installed or Previously Designed Superstructures⁺</i> <i>2001 Cost Base</i>
\$ 2,500

^{**} Includes all site specific professional and non-professional costs for survey, production of a site plan and general arrangement.

⁺ Assumes the proponent is already in possession of engineered drawings for a steel superstructure. Includes when a new superstructure is being fabricated from standard drawings or when an existing superstructure is being reinstalled at its original design loading or less.

Table 6-1-C. Construction Certification Cost Estimates for all Bridges.

<i>Construction Certification Cost Estimate[*]</i> <i>2001 Cost Base</i>		
Bridge Length	≤ 24 m	> 24 m
Temporary	\$ 1,000	\$ 3,000
Permanent	\$ 3,000	Submit Detailed Estimate

^{*} Assumes maximum site visits and the production of an FS 138 Certification of Construction of Bridges or a similar document, prepared by a Professional Engineer.

REGIONAL COST TABLES FOR BRIDGE SUPERSTRUCTURE SUPPLY

Table 6-2-A. Bridge Superstructure Supply Cost for CL-625 Steel Bridges.

Superstructure Supply ¹ Cost ² for CL-625 Bridges 2001 Cost Base				
<u>Bridge Span (metres)</u>	<u>Steel³ and Timber</u>		<u>Steel³ and Concrete⁵</u>	
	<u>Non-Treated Timber</u>	<u>Treated Timber⁴</u>	<u>Non- Composite⁶</u>	<u>Composite⁷</u>
6	\$ 9,000	\$ 14,000	\$ 15,500	\$ 15,500
7	\$ 11,000	\$ 16,000	\$ 18,500	\$ 18,500
8	\$ 13,000	\$ 18,000	\$ 20,100	\$ 20,700
9	\$ 14,550	\$ 18,800	\$ 21,200	\$ 21,600
10	\$ 16,100	\$ 20,100	\$ 22,300	\$ 23,100
11	\$ 17,650	\$ 22,100	\$ 25,300	\$ 25,400
12	\$ 19,200	\$ 24,400	\$ 28,200	\$ 28,000
13	\$ 20,750	\$ 26,200	\$ 31,600	\$ 30,100
14	\$ 21,525	\$ 27,900	\$ 34,900	\$ 32,100
15	\$ 22,300	\$ 29,800	\$ 37,100	\$ 34,300
16	\$ 25,100	\$ 33,100	\$ 38,400	\$ 39,200
17	\$ 27,900	\$ 36,600	\$ 40,260	\$ 42,100
18	\$ 30,700	\$ 38,800	\$ 42,680	\$ 45,100
19	\$ 33,500	\$ 41,800	\$ 45,980	\$ 47,500
20	\$ 36,300	\$ 45,100	\$ 49,610	\$ 49,900
21	\$ 39,100	\$ 47,500	\$ 52,250	\$ 52,800
22	\$ 41,900	\$ 49,700	\$ 54,700	\$ 55,800
23	\$ 44,700	\$ 53,600	\$ 59,000	\$ 59,800
24	\$ 47,500	\$ 57,500	\$ 63,250	\$ 63,800

¹ Superstructure includes all girders, decking materials, ballast walls, curbs and rails, bearing pad assemblies and miscellaneous steelwork and hardware.

² Includes all fabrication and/or purchase costs, costs for in-plant design and inspection, all applicable taxes and freight charges. Assumes installation site is within 250 kms by road of the Point of Appraisal as defined by the IAM. See Table 6-9 for additional mobilization.

³ Assumes steel girders fabricated with 350AT steel.

⁴ Assumes CCA treatment or equivalent for timber.

⁵ Assumes pre-cast reinforced concrete decking, ballast walls and pile cap (if applicable).

⁶ Non-composite steel and concrete bridge where the deck does not act as a load-sharing member and the vehicle loading is supported by the girders.

⁷ Composite steel and concrete bridge with continuous deck with panels welded or grouted to each other. The deck is intimately connected to girder. This type of bridge requires a Professional Engineer's design regardless of length.

Table 6-2-B. Bridge Superstructure Supply Cost for L100 Steel Bridges (2001 Cost Base).

Superstructure Supply ¹ Cost ² for L100 Bridges 2001 Cost Base				
Bridge Span (metres)	Steel³ and Timber		Steel³ and Concrete⁵	
	Non-Treated Timber	Treated Timber⁴	Non- Composite⁶	Composite⁷
6	\$ 11,000	\$ 15,000	\$ 16,500	\$ 16,500
7	\$ 12,700	\$ 17,000	\$ 19,500	\$ 20,000
8	\$ 14,300	\$ 19,800	\$ 22,100	\$ 23,800
9	\$ 16,000	\$ 20,700	\$ 23,300	\$ 24,800
10	\$ 17,700	\$ 22,100	\$ 24,500	\$ 26,500
11	\$ 19,300	\$ 24,300	\$ 27,800	\$ 29,200
12	\$ 21,000	\$ 26,800	\$ 31,000	\$ 32,200
13	\$ 22,700	\$ 28,800	\$ 34,700	\$ 34,400
14	\$ 24,300	\$ 30,700	\$ 38,300	\$ 36,900
15	\$ 26,000	\$ 33,500	\$ 40,800	\$ 39,400
16	\$ 29,700	\$ 37,500	\$ 42,200	\$ 43,900
17	\$ 33,400	\$ 42,500	\$ 44,200	\$ 47,100
18	\$ 37,200	\$ 47,700	\$ 47,000	\$ 50,500
19	\$ 40,900	\$ 50,800	\$ 50,500	\$ 53,200
20	\$ 44,600	\$ 54,000	\$ 54,500	\$ 55,900
21	\$ 48,300	\$ 56,800	\$ 57,500	\$ 58,100
22	\$ 52,000	\$ 59,600	\$ 60,100	\$ 61,500
23	\$ 55,700	\$ 64,600	\$ 64,900	\$ 65,700
24	\$ 59,500	\$ 69,500	\$ 69,600	\$ 70,100

¹ Superstructure includes all girders, decking materials, ballast walls, curbs and rails, bearing pad assemblies and miscellaneous steelwork and hardware.

² Includes all fabrication and/or purchase costs, costs for in-plant design and inspection, all applicable taxes and freight charges. Assumes installation site is within 250 kms by road of the Point of Appraisal as defined by the IAM. See Table 6-9 for additional mobilization.

³ Assumes steel girders fabricated with 350AT steel.

⁴ Assumes CCA treatment or equivalent for timber.

⁵ Assumes pre-cast reinforced concrete decking, ballast walls and pile cap (if applicable).

⁶ Non-composite steel and concrete bridge where the deck does not act as a load-sharing member and the vehicle loading is supported by the girders.

⁷ Composite steel and concrete bridge with continuous deck with panels welded or grouted to each other. The deck is intimately connected to girder. This type of bridge requires a Professional Engineer's design regardless of length.

REGIONAL COST TABLES FOR INSTALLATION OF SUBSTRUCTURE

The following cost tables are to be used for developing the ECE for the supply and installation of various substructure types. A single bridge may utilize two different foundation or abutment types, and therefore, cost estimates from two different tables.

Tables include all costs related to the supply and installation of one abutment including:

- supply, placement and compaction of endfill;
- supply and installation of approach fills to 15 metres of each end of the bridge, including culverts;
- shaping and grading to form a completed subgrade;
- supply and placement of rip rap;
- supply and placement of geotextile;
- supply and installation of any signs, delineators or other road markers;
- erection of foundations; and
- freight and mobilization and demobilization (see Table 6-9 for more information).

Table	Substructure Type
6-3-A	Interlocking Pre-cast Concrete Blocks
6-3-B	Post and Pad Foundation
6-3-C	Steel Pipe Pile Foundation
6-3-D	Timber Cribs

The following cost tables are to use for developing the ECE for the supply and installation of a single bearing cap or sill.

Table	Substructure Type
6-4-A	Bearing Caps
6-4-B	Bearing Sills

Table 6-3-A. Single Foundation Cost for Interlocking Pre-cast Concrete Block Abutment.

Single Foundation Cost: Interlocking Pre-cast Concrete Blocks based on Number of Tiers or Row 2001 Cost Base			
<u>Number of Tiers or Full Rows per Abutment</u>			
<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
\$ 2,100	\$ 3,900	\$ 6,400	\$ 10,000

Table 6-3-B. Single Foundation Cost for Post & Pad Foundation.

Single Foundation Cost: Post and Pad Foundation ¹ based on total height of abutment from base of footing (meters) 2001 Cost Base				
<u>Height of abutment from base of footing (meters)</u>				
0.5-1.5	>1.5-2.5	>2.5-3.5	>3.5-4.5	>4.5-5.5
\$ 2,500	\$ 6,500	\$ 9,500	\$ 12,000	\$ 15,600

¹ Does not include cost of the bearing pads. See Table 6-4-B.

Table 6-3-C. Single Foundation Cost for Steel Pipe Pile Abutment.

Single Foundation Cost: Steel Pipe Piles based on height of pile above the natural ground line 2001 Cost Base				
<u>Height of piling above natural ground line (meters)</u>				
0.5-1.5	>1.5-2.5	>2.5-3.5	>3.5-4.5	>4.5-5.5
8,250	9,500	12,250	14,500	19,000

Table 6-3-D. Single Foundation Cost for Timber Crib Construction.

Single Foundation Cost: Timber Crib based on crib height 2001 Cost Base						
<u>Height of crib above natural ground line at middle of crib face (meters)</u>						
0.5-1.5	>1.5-2.5	>2.5-3.5	>3.5-4.5	>4.5-5.5	>5.5-6.5	>6.5-7.5
\$ 3,400	\$ 6,700	\$ 10,000	\$ 14,700	\$ 18,400	\$ 22,000	\$ 25,600

Table 6-4-A. Single Foundation Cost for Bearing Caps (Supply and Installation).

Single Foundation Cost: Bearing Cap based on designed type 2001 Cost Base		
Treated Timber	Reinforced H-Pile	Pre-cast Concrete Cap
12 x 12 - \$ 300	\$ 1,200	\$ 3,000
16 x 16 - \$ 400		

Table 6-4-B. Single Foundation Cost for Bearing Sills (Supply and Installation).

Single Foundation Cost: Bearing Sill Construction based on designed type 2001 Cost Base			
Non-treated Timber	Treated Timber ¹	Pre-cast Concrete Pad	Cast-in-Place Concrete Pad ²
\$ 250	\$ 400	\$ 1,500	\$ 2,500

¹ Assumes CCA treatment.

² Cast-in-place on bedrock with 2 pads per abutment. Includes dowlings and anchors.

REGIONAL COST TABLE FOR INSTALLATION OF SUPERSTRUCTURE

Table 6-5 is to be used for developing the ECE for the installation of the bridge superstructure. The tables include all costs associated with the erection and assembly of permanent or portable bridge superstructures including:

- site preparation (labour and equipment);
- mobilization and demobilization of labour and specialized equipment, and
- erection of bridge superstructure on a suitable foundation.

These installation tables are not for use for construction of log stringer bridges or wooden box culverts.

Table 6-5. Bridge Superstructure Installation Cost for Steel/Timber or Steel/Concrete Superstructures.

<i>Superstructure Installation Cost Estimates based on overall bridge span (meters) 2001 Cost Base</i>					
Bridge Span out-to-out (meters)					
6 – 9	>9 – 12	>12 – 15	>15 – 18	>18-21	>21 – 24
\$ 9,200	\$ 9,800	\$ 11,500	\$ 15,500	\$ 17,500	\$ 19,000

REGIONAL COST TABLE FOR ADDITIONAL COST ITEMS

Table 6-6. Supply, Installation and Removal Cost for a Work Bridge.

<i>Work Bridge Supply, Installation and Removal Cost¹ based on work bridge span 2001 Cost Base</i>			
Work Bridge Span out-to-out (meters)			
≤ 10	10 - <15	15 - <20	>20
\$ 2,500	\$ 3,500	\$ 5,000	\$ 7,000

¹ Where use and span length of work bridge has been justified.

Table 6-7. Cost for removal and transport of a Portable Bridge Superstructure to a new installation site.

<i>Portable Bridge Superstructure Removal and Transport Cost based on bridge span¹ 2001 Cost Base</i>					
Span (out-to-out) of Portable Bridge (meters)					
6 – 9	>9 – 12	>12 – 15	>15 – 18	>18-21	>21 – 24
\$ 2,500	\$ 2,700	\$ 3,500	\$ 6,000	\$ 7,500	\$ 8,500

¹ Span of portable being removed.

Table 6-8. Cost for removal and transport of Interlocking a Pre-Cast Block Foundation to a new installation site.

<i>Interlocking Pre-Cast Block Foundation Removal and Transport Cost based on foundation height removed 2001 Cost Base</i>			
Number of Tiers or Rows of Lock Blocks Removed			
1	2	3	4
\$ 700	\$ 850	\$ 1,450	\$ 3,000

Table 6-9. Approved Additional Costs for Additional Mobilization.

<i>Additional Mobilization Costs 2001 Cost Base</i>		
Location	Rational	Additional Cost¹
Any site >250kms by road to Point of Appraisal		Lowbed hours for allowable supplies and equipment beyond 250 kms
Bear Lake	Rail Access Only	Rail Freight Cost
Minaret Creek	Rail Access Only	Rail Freight Cost
Niteal	Rail Access Only	Rail Freight Cost
Kitimat Channel	No Road Access	Barge Freight Cost
Bear Valley	Barge Access	Barge Freight Cost

¹ The proponent may be required to provide documentation of barge or rail cost.

Example of a Bridge ECE using Regional Cost Tables

The proponent requires a 24 metre long CL-625 steel and timber bridge to be installed within 250 kms of the Point of Appraisal. The bush end is founded on a shallow foundation of less than 1 metre consisting of a cast-in-place concrete footing doweled into bedrock. The town end is on driven pipe piles of 1.7 metres with a concrete cap.

Engineering Services:

Survey and Design	Table 6-1A	\$ 7,000	
Construction Certification	Table 6-1C	\$ 3,000	
	Subtotal Survey and Design	\$	10,000.

Superstructure:

Superstructure supply	Table 6-2A	\$ 57,500	
Superstructure Installation	Table 6-5	\$ 19,000	
	Subtotal Superstructure	\$	76,500.

Foundation:

(Bush) Pile bent (1.0 metre)	Table 6-3B	\$ 2,500	
(Bush) Cast in place pads	Table 6-4B	\$ 2,500	
(Town) Steel Pipe Piles (1.7 m)	Table 6-3C	\$ 9,500	
Pre-Cast Concrete Bearing Cap (2) (2 at \$3,000 each)	Table 6-4A	\$ 6,000	
	Subtotal Foundation	\$	20,500

Total Allowable ECE \$ 107,000

REGIONAL COSTS TABLE FOR CONSTRUCTION OF WOOD BOX CULVERTS

Table 6-10 is to be used for developing the ECE for the construction of wood box culverts up to a span of 15.4 metres and log sill heights up to 2.0 metres. The tables include all costs associated with the supply and installation including:

- transportation of the timber materials from the road permit area or the cutting authority area,
- all labour, equipment and material cost,
- mobilization and demobilization of any specialized equipment,
- construction of single or multiple sill log abutments including sill log and mud sills, or log bundles, or foundation logs with spacer sills and bearing sills.

The costs in Table 6-10 are based on the following assumptions for construction:

- the timber materials utilized are available on site;
- timber preparation is minimal (no peeling or daping);
- gravel overlay or running surface; and
- lashing is provided as retention of the log stringers.

Table 6-10. Cost Estimate for Supply and Installation of Wood Box Culverts.

Wood Box Culvert Construction Cost Estimate based on sill height and culvert span 2001 Cost Base						
	Culvert Span (metres)					
Sill Height (metres)	4 m	5 m	6 m	7 m	8 m	9 m
0.0 – 1.0	\$ 2,000	\$ 2,500	\$ 3,000	\$ 3,500	\$ 4,000	\$ 4,500
>1.0 –2.0	\$ 3,000	\$ 3,750	\$ 4,500	\$ 5,250	\$ 6,000	\$ 6,750

	Culvert Span (metres)					
Sill Height (metres)	10 m	11 m	12 m	13 m	14 m	15 m
0.0 – 1.0	\$ 5,000	\$ 5,500	\$ 6,000	\$ 6,500	\$ 7,000	\$ 7,500
>1.0 –2.0	\$ 7,500	\$ 8,250	\$ 9,000	\$ 9,750	\$ 10,500	\$ 11,250

**ITEM 7:
STRUCTURAL MAINTENANCE OF BRIDGES, SUBSTRUCTURE
AND CRIBWORK**

7.0 Statement

Structural maintenance of bridges, substructure and cribwork.

7.1 Definition

Structural maintenance is the repair and/or replacement of a structural component or load bearing member of a bridge. Structural maintenance is limited to repair of, or replacement with, similar or comparable materials that meet the original design standard. Where structural changes are proposed that change the load rating or physical properties of a structure, those changes are considered upgrading and are administered under Item 9.

Structural maintenance **includes**, but may not be limited to:

- replacement of rip rap when volume exceed 50 cu. meters;
- repair or replacement of structural back-fill (i.e. endfill);
- repair or replacement of structural plates, for multi-plate structures;
- repair or replacement of structural components for non-structural plate structures [this includes replacement of failed (collapsed) pipe sections];
- repair or replacement of cross-ties;
- repair or replacement of log or timber cribs;
- repair or replacement of panels for panel component type bridges (i.e.ACROW or Bailey bridges);
- repair or replacement of foundation and/or bearing components;
- repair or replacement of concrete deck panels or structural steel deck panels, where repair is required on more than 10% of the deck area;
- removal and re-installation of fill when done in conjunction with structural works; and
- replacement of timber decking, only where done in conjunction with cross-tie replacement.

Structural maintenance **does not include** these items:

- replacement or repair of timber decking, unless associated with repair or replacement of structural components;
- repair, removal or replacement of gravel on gravel decked structures;
- repair or replacement of asphalt or concrete topping (wearing surface) on bridge decks or approaches;
- the replacement or repair of curb rails, risers or connectors;
- the replacement or repair of approach guard rail systems; and
- the placement of less than 50 m³ of rip rap.

7.2 Application

Structural maintenance estimates will not be accepted where the obligatory maintenance has not been undertaken, where the structure was incorrectly sized for the stream or where a failure is caused by improper installation.

The requirement to replace or repair a structural component of a bridge must be documented in an inspection by a person qualified to conduct bridge inspections.

Where replacement of concrete deck panels or structural steel panels is proposed, the project details must be referred to the MoFR for pre-approval.

The Regional Bridge Engineer, prior to the commencement of works, must approve all structural maintenance on Forest Service Road bridges, with the exception of emergency situations. Where required by the Regional Bridge Engineer, the work may require design and/or supervision by a Professional Engineer. The costs associated with the survey, design and supervision in this situation will be allowed as part of the structural maintenance ECE.

Structural maintenance of major load carrying members (girders) and substructure components must be carried out under the supervision of and follow a design prepared by a Professional Engineer. Where the services of a Professional Engineer are required for the design, supervision and/or certification of structural repairs, the fees for services will be accepted as part of the ECE.

7.3 Submission Requirements

The proponent will provide the following information to support the ECE for structural maintenance:

- Copy of the documented inspection by a qualified bridge inspector indicating the condition of the structure or the individual structural component requiring repair or replacement;
- Copy of drawings for repair or replacement of those components requiring a design by a Professional Engineer.
- When requested, copies of previous inspection reports with information regarding maintenance history of bridge component being repaired or replaced.

7.4 ECE Determination

The ECE for structural maintenance may use any of the three approved methods for preparing an ECE as outlined in Section B.1 of the Procedures. Values contained in Table 7-1 are for the replacement of some structural components.

The ECE may contain all costs associated with the professional design, repair/replacement of the structural component and certification of the structural maintenance. Supervision costs will only be recognized for repair or replacement of components that are considered complex.

Table 7-1. Structural Maintenance Costs for Specific Replacement Projects.

<i>Structural Maintenance Cost Total Cost for removal, supply and installation 2001 Cost Base</i>	
Cross-tie Replacement	\$300.00 per lineal meter of deck
L60, L75 or CL-625 untreated deck panel replacement	\$1,900 per panel
L60, L75 or CL-625 treated deck panel replacement	\$2,500 per panel
L100 untreated deck panel replacement	\$2,700 per panel
L100 treated deck panel replacement	\$3,700 per panel
Reinforced concrete deck replacement	\$1,500.00 per lineal meter of deck

ITEM 8: RECONSTRUCTION OF ROADS AND PERTINENT STRUCTURES

8.0 Statement

Reconstruction of roads and pertinent structures. Cost estimates for reconstruction are not to exceed the tabular cost for new construction under similar conditions.

8.1 Definition

Reconstruction is defined as the re-establishment of the road prism to its original pre-existing condition by repairing damage to the road subgrade resulting from natural forces or restoring the road carrying capacity to meet the design vehicle loads.

Reactivation is defined as the reconstruction of a permanently deactivated road (for which a licensee does not have road maintenance obligations) to its original design. Reactivation does not include any change or increase in the road standard, including any work to address current regulatory requirements for safety or drainage.

8.2 Application

Reconstruction may be undertaken where an existing road is not capable to withstanding the design vehicle loads or where the operational function of the road has been lost. The operational function of a road may be impaired through either a major event (storm) or through the deterioration of the road or structure over time when maintenance obligations did not apply. No ECE for reconstruction will be recognized if the licensee has been negligent or has not followed approved plans or standards as defined under applicable Provincial Acts and Regulations.

An ECE for reactivation will not be considered when a proponent has failed to meet the regulatory requirements for deactivation, has not met their permit requirements or did not apply the standards of the day for permanent deactivation.

Neither reconstruction nor reactivation applies if there is a proposed change in the physical road standard, such as an increase in the effective running surface width. Changes in the road standard, such as an increased road width or realignment, are considered upgrades and are administered under Item 9 of the Procedures.

8.3 Submission Requirements

The proponent will submit sufficient information to substantiate the submitted ECE. This may include a geometric road design, including plans, profiles and cross-sections, for road sections requiring major reconstruction. For those sections where the cost table values are applied, the proponent will specify the applicable total ECE section and define the locations for each item (ditching and brushing) within the total ECE section.

8.4 ECE Determination

An ECE for the reconstruction or reactivation of a road section may use any of the three approved methods for preparing an ECE as outlined in Section B.1 of the Procedures.

An ECE for road reconstruction, including reactivation, may not exceed the tabular subgrade cost estimate for new construction under similar conditions. To determine the maximum allowable ECE value, the tabular subgrade cost is calculated using the appropriate road group equation from section 4.3.2.3 of the IAM using the appropriate construction variables.

8.4.1 ECE Determination for Reconstruction of a Road Subgrade

An ECE approved for subgrade reconstruction of a permitted road under this section will not include any activities described as road management in section 4.6 of the IAM.

8.4.2 ECE Determination for Reactivation of a Road

For an ECE approved for reactivation, the formula in Table 8-1 will be used to determine the allowable percentage of the tabular cost which may be applied to the ECE section. The steps outlined in Table 8-2 will be used to determine the allowable unit cost per kilometre for reactivation. The proponent shall provide all calculations used to determine the final reactivation cost with the detailed ECE.

Where columns A, B and C inclusively do not apply to the reactivation works, Tables 8-1 and 8-2 do not apply. Where the deactivation consists solely of the removal of cross-ditches and installation of new culvert, the following cost allowances apply:

- For supply and installation of culverts: Table 4-4 (Culvert Cost Estimates) of the *Interior Appraisal Manual* applies.
- For removal (filling in) of cross-ditches: \$50.00 per cross-ditch

Field notes and measurements substantiating the requirement for reactivation will be recorded by the proponent. Individual road sections requiring reactivation work must be at least 100 meters in length with the current road conditions and required works averaged across each individual section.

Given significant changes to the legislation over time and the various scenarios, each application for an ECE for road reactivation will be assessed on its own merits.

A transfer of a Forest License or a reallocation of planning cells does not qualify for the test of no prior maintenance obligations.

Where additional works are necessary to reconstruct the road, they may be submitted as a detailed ECE under the applicable ECE item. Examples of these additional works may include the replacement of the road running surface or the reconstruction of bridges, major culverts, or special structures.

Table 8-1. Reactivation of Roads.

<i>Road Reactivation Cost (as a percentage of Subgrade Cost Estimate from IAM)</i> <i>Total Cost for reactivation of existing road to pre-existing condition</i> <i>Same cost base as IAM</i>				
Current Road Condition (each ECE Section)				
Percent of ditch line requiring construction or re-establishment ¹ (%Ditch)	Average height of brush on the running surface ² (Avg Ht)	Percent of road running surface occupied by brush ³ (%Brush)	Total Points (A + B + C)	% of Tabular (Total Points ÷ 400)
A = %Ditch	B = Avg Ht × 10	C = %Brush × 2		

¹ Percent (%) Ditch is defined as the total lineal meters of ditches requiring cleaning, re-establishment or new construction divided by the end total of lineal meters of functional ditch line for that section. The measurement of lineal meters of ditch line can include the length of required ditching on either side of the road. The percent ditch is to be rounded up or down to the nearest 10 percent.

² Average Height of brush on the running surface of the ECE Section is based on ocular estimates. The maximum value for average height is 10 meters; therefore, if brush exceeds 10 meters in average height, use 10 meters in the calculation of B. Average height is to be rounded up or down to the nearest meter.

³ Percent of Road running surface occupied by the brush is based on ocular estimates and applies to the same brush used to determine Average Brush Height. The percent occupied is to be rounded up or down to the nearest 10 percent.

Table 8-2. Calculation of Cost per Kilometre for Reactivation.

<i>Road Reactivation Cost (cost per kilometre)</i> <i>Unit Cost for reactivation of existing road to pre-existing condition</i> <i>Same cost base as IAM</i>				
% of Tabular ¹	Applicable Road Group	Modified Subgrade Cost Estimate Equation (Section 4.3.2.3 IAM) ²	Maximum Cost for Reactivation (\$/km) ³	Allowable Cost for Reactivation (\$/km) ⁴
				%Tabular × Maximum Cost

¹ From formula presented in Table 8-1.

² A modified version of the equation for subgrade cost estimate is used in determining the maximum value for reactivation. The variables for uphill side slope (SLOPE%) and percent rock (ROCK%) are excluded from the formula.

³ The remaining variables in the modified subgrade cost estimate are set to either 0 or 1 as defined in Section 4.3.2.3 of the IAM based on the originally designed or constructed road standard.

⁴ The allowable ECE cost is calculated as the % of Tabular multiplied by the Maximum Cost. This allowable cost is then applied against the total length of road requiring reactivation. This is an all-found cost which includes all work items listed in Section 4.3.2.1 of the IAM.

Example Calculation for the Reconstruction and Reactivation of Roads

For a permanently deactivated operational standard road in Mackenzie (Road Group 7), 150 meters road must be reactivated. In the 150 meter ECE section, a total of 200 meters of functional ditch line is required. Currently only 135 meters is functional, and 65 meters must be re-established and/or constructed. The running surface is 20% occupied by brush which is 2.5 to 3.0 meters in height. For this road section, the percent tabular is calculated as follows:

Percent of ditch line (%Ditch)	Average height of brush on the running surface ² (Avg Ht)	Percent of road running surface occupied by brush ³ (%Brush)	Total Points (A + B + C)	% of Tabular (Total Points ÷ 400)
65 m ÷ 200 m = 0.325 % Ditch = 30% (rounded down)	Average is 2.75 m Avg Ht = 3 (rounded up)	Estimate 20% % Brush = 20 (no rounding)	(30 + 30 + 40)	(100 ÷ 400)
A = %Ditch A = 32.5 A = 30 (rounded down)	B = Avg Ht × 10 B = 3 × 10 B = 30	C = %Brush × 2 C = 20 × 2 C = 40	A + B + C = 100	0.25 or 25%

For the above road, the percent of tabular was calculated at 25%. The road was originally constructed to an operational standard to which it is being restored (OP = 1). The road is located in the Sub Boreal Spruce biogeoclimatic zone (SBS = 1). The calculation of the allowable unit cost for reactivation is as follows:

% of Tabular	Applicable Road Group	Modified Subgrade Cost Estimate Equation (Section 4.3.2.3 IAM) ²	Maximum Cost for Reactivation (\$/km) ³	Allowable Cost for Reactivation (\$/km) ⁴
25%	7	Original Formula: 4600 + (192 × SLOPE%) + 4725(ESSF) + 24998(ESSF × OP) + 5904(BWBS × OP) + 7129(SBS × OP)	4600 + 7129(1 × 1)	11 729 × 25%
		Modified Formula: 4600 + 7129(SBS × OP)	= \$11,729 per km	= \$2,932.25 per km

For the ECE section in question, the allowable ECE cost for reactivation is calculated as the unit price of \$2,932.25 multiplied by the length of 150 meters (0.150km). This would result in an ECE of \$439.84 total.

ITEM 9: UPGRADE OF ROADS AND PERTINENT STRUCTURES

9.0 Statement

Upgrade of roads and pertinent structures. Road upgrade resulting in a change in the standard of the road and structure or where the licensee was not obligated to carry out road maintenance prior to the appraisal. Where road maintenance obligations exist, road upgrade is limited to widening the running surface, vertical and horizontal realignment, and additional culverts.

9.1 Definition

This section applies to road sections where road upgrade works result in a change (improvement) in the standard of the road or structure.

9.2 Application

The upgrade of a road or structure may occur for several reasons, including:

- To address changes in development planning that require the road to handle additional timber volume or to increase road speeds;
- To improve known safety hazards through a change to the alignment, an increase in road width or an upgrade to a structure; or
- To address documented environmental deficiencies for structures constructed prior to June 15, 1995.

Where an upgrade is warranted, the allowable cost items in the ECE will depend on whether the licensee had maintenance obligations prior to the upgrade work.

Where a licensee had maintenance obligations prior to the works, the ECE will reflect only those phase costs directly associated with the upgrade. No costs will be approved for any work that is listed in section 4.6 of the IAM for Road Management.

Where a licensee did not have maintenance obligations prior to the upgrade work, the ECE may include all phases of construction including costs for work covered under section 4.6 of the IAM for Road Management.

A transfer of a Forest License or a reallocation of planning cells does not qualify for the test of no prior maintenance obligations.

9.3 Submission Requirements

The proponent will provide the following information to support an ECE for road upgrade:

- Rationale for the road upgrade, including any benefits that will be derived from the work;
- For upgrade to road alignment or width, a geometric road design, including plans, profiles and cross-sections. The design must identify the ground profile, final grade

- lines, road width, drainage structures, cut and fill slopes and soil types for the entire road length proposed as an ECE;
- For road stabilization, a typical cross-section showing road width, depth of stabilization material and fill slopes;
 - Volume calculations and mass haul diagram, and
 - Location of borrow pits, gravel pits, rock quarries and/or waste sites.

9.4 ECE Determination

The ECE may be determined by either a detailed ECE calculation or through a public tender as outlined in Section B.1 of the Procedures. The ECE will be volume based (bank m³), and based on the volume calculations included in the geometric road design and volume calculations submitted with the ECE.

All phase construction costs, including costs for road survey and design, can be included in the detailed ECE, with the exception of right of way logging costs.

For an upgrade to the road alignment or an increase in the road width, the ECE may contain costs for grubbing and stripping, subgrade construction, drainage construction and surfacing. For stabilization the costs are limited to the supply, transportation, placement and compaction of the stabilizing material.

For any road upgrade, road management costs (section 4.6 of the IAM) may only be included where no maintenance obligations existed prior to the upgrade work being completed.

ITEM 10: REPLACEMENT OR ADDITION OF STABILIZING MATERIAL

10.0 Statement

Replacement or addition of stabilizing material to existing road running surfaces or where stabilizing material was not previously used, for uninterrupted lengths of 0.3 km, or greater. Lengths less than 0.3 km are included in road management (section 4.6).

10.1 Definition

This section applies to the replacement of the road running surface on a previously surfaced road for a minimum section length of 300 meters. Each 300 meter section must be continuous or uninterrupted, otherwise it qualifies as road management under section 4.6 of the IAM.

This section will also cover the stabilization of a previously unstabilized subgrade to achieve an all-season road access. The road must not have received a previous cost allowance for tabular stabilization to qualify for an ECE as a previously unstabilized road.

10.2 Application

This section applies to Forest Service and operational roads that were initially surfaced and where the surface material has been lost due to extensive wear and tear. This section also applies to previously unstabilized operational or block roads which are now required for all-season road access.

This ECE item does not include the replacement or recovery of gravel that should have been retained on the road surface through normal surface maintenance. Recovery of gravel from ditches is not considered replacement of gravel regardless of length.

The depth of material to be applied must be sufficient to provide a running surface and to provide adequate carrying capacity for the design vehicle loads.

10.3 Submission Requirements

The proponent will provide the following information to support an ECE for replacement of running surface:

- Location of material sources;
- Volume of material to be applied;
- Representative cross-section to support volume calculations;
- Construction equipment employed; and
- Equipment productivities and rates.

10.4 ECE Determination

The ECE may be determined by either a detailed ECE calculation or through a public tender as outlined in Section B.1 of the Procedures. The ECE will be volume based (bank m³) and the volume calculations based on the representative cross-section submitted with the ECE.

As outlined in B.1.4, the proponent may apply the tabular formula from section 4.3.2.5 of the IAM as the ECE. This is an all-found cost which includes those items listed in section 4.3.2.5 of the IAM.

The detailed ECE calculation or tender may include all phase costs including borrow/gravel pit preparation, gravel or rock production costs, loading, transportation, placement, and compaction. The ECE is not constrained by the formulas from section 4.3.2.5 of the IAM.

ITEM 11: NON TABULAR CULVERTS

11.0 Statement

Culverts greater than 1.8 meters in diameter when specified in the cutting authority or road permit. Culverts greater than 30 meters in length regardless of diameter also qualify. The cost estimate includes all costs of transporting the culvert to the jobsite and all costs of installation of the culvert to the subgrade stage.

11.1 Definition

This section applies to culverts greater than 1800mm in diameter or equivalent to a corrugated steel pipe greater than 1800mm in diameter. This provides for the use of elliptical pipe arches (>2130mm x 1400mm), oval or other designed pipe profiles. This section also applies to culverts greater than 30 meters in length regardless of diameter.

11.2 Application

Culverts that meet the definition of a Special Structure under Item 13 of the Procedures, such as embedded culverts, will be administered under that ECE item.

11.3 Submission Requirements

The proponent will submit the following information to support the engineered cost estimate:

- Riparian class of the stream (must indicate if it is a default classification).
- For culverts greater than 1800mm in equivalent diameter, a site plan which includes:
 - High water mark;
 - Stream velocity and direction;
 - Streambed materials;
 - Cross-sections at centreline and at intervals upstream and downstream;
 - Plan view and profile view of the watercourse; and
 - Date of survey.
- For culverts greater than 1800mm equivalent diameter, a general arrangement which includes:
 - Culvert dimensions and type;
 - Horizontal and vertical alignment of the culvert in relation to the stream;
 - Road centerline;
 - Extents and volumes for foundation material and structural fill envelope;
 - Road subgrade volumes to the top of subgrade based on fill lines and extent of structural fill envelope;
 - Extents, volume and class of rip rap.
- For culverts greater than 30 metres in length:
 - Culvert dimensions and type;
 - Extents and volumes for foundation material and structural fill envelope;
 - Road subgrade volumes to the top of subgrade based on fill lines and extent of structural fill envelope;

- Extents, volume and class of rip rap.

The proponent will identify the design standard applied and where there is a requirement for a design to be prepared by a professional engineer, the proponent will supply a set of sealed design drawings with the ECE. Professional design costs will be accepted for the design of major culverts where incurred.

11.4 ECE Determination

The ECE may be determined by either a detailed ECE calculation or through a public tender as outlined in Section B.1 of the Procedures. The ECE will be volume based (bank m³) for the earthworks portion, including rip rap, with the volume calculations shown on the design submitted with the ECE.

The ECE may include all costs associated with the design, purchase, transportation and installation of the culvert to the final sub-grade stage. Costs for the following items may be included in the ECE:

- Production of a site plan and general arrangement (if submitted);
- Purchase cost of culvert components;
- Transportation (freight) for materials;
- Mobilization and demobilization of specialized equipment;
- Site preparation;
- Temporary creek diversion, if required;
- Supply, placement and compaction of foundation (volume as per design);
- Supply, placement and compaction of structural fill envelope (volume as per design);
- Supply and placement of general fill for road subgrade (volume as per design);
- Supply and placement of rip rap or scour protection (volumes as per design);
- Supply and installation of any roadside barriers, hazard markers or required signage, and
- Supervision by a Professional Engineer (complex structures only).

ITEM 12: ADDITIONAL STABILIZING MATERIAL

12.0 Statement

Placement of additional stabilizing material where geotech fabric, corduroy, crushed and/or screened rock/gravel are used.

12.1 Definition

As stated in Section 4.3.2.5 of the IAM, “road stabilization is the placement of gravel or broken rock on the road subgrade to provide stable support and a running surface for logging equipment using the road during the harvesting of tributary timber.” A tabular allowance for additional stabilizing material is applied when the stabilizing materials developed during the subgrade and/or ditch construction are insufficient and additional stabilizing material must be trucked in from selected borrow pits.

When additional stabilizing material is placed in conjunction with special materials, such as geotextile, geogrids, corduroy, or where the stabilizing materials requires processing, such as the screening or crushing of gravel and/or rock, an ECE may be granted in lieu of tabular additional stabilizing.

An ECE for additional stabilizing may be given when the proponent has adequately demonstrated the need to apply special materials to the road to adequately stabilize the grade and produce the necessary running surface for the designed haul speed.

12.2 Application

The need to apply special materials to adequately stabilize the subgrade may occur in the following situations:

1. Where, without the use of special materials or processing, the subgrade would require stabilization with a minimum of 500 mm of suitable material which is unavailable or cost prohibitive; and
2. Where the designed load carrying capacity cannot be attained without the application of special materials or processing.

Where the use of available materials (pit run or blasted rock) will adequately stabilize the road, but the proponent can adequately demonstrate that the use of crushed rock or gravel is required and will provide an improved running surface for an increased haul speed, increased safety or to address public use is required.

12.3 Submission Requirements

The proponent will provide the following information to support an ECE for additional stabilization:

- Rationale for the use of special materials for stabilization;

- Location of material sources;
- Volume of material to be applied;
- Representative cross-section to support volume calculations;
- Construction equipment employed;
- Equipment productivities and rates; and
- Where Table 12-4 is used, the road grades and lengths used to determine the average road grade percent.

Where the proponent applies for an ECE under this item, they are obligated to demonstrate that the materials developed or that will be developed during sub-grade construction and materials available in select pits (including quarries) will not adequately stabilize the subgrade, without the use of special materials or processing.

12.4 ECE Determination

An ECE for the additional stabilization may use any of the three approved methods for preparing an ECE as outlined in Section B.1 of the Procedures. The ECE will be volume based (bank m³) and the volume calculations based on the representative cross-section submitted with the ECE.

The detailed ECE calculation or tender contract may include all phase costs, except for supervision, including:

- Supply, transportation and installation of geofabrics or corduroy;
- Borrow or gravel pit development;
- Quarry development and blasting, if applicable;
- Loading, hauling, placing and compaction of processed material, if approved;
- Loading, hauling, placing and compaction of pit run material when used with geofabrics or corduroy.

As outlined in B.1.4, the proponent may apply the tabular formula from section 4.3.2.5 of the IAM as part of a detailed ECE calculation. The tabular rate is an all-found cost for the supply, including pit development, transportation, placement and compaction of stabilizing materials as outlined in the IAM. The costs for the supply, transportation, and installation of special materials and/or the costs for processing of the stabilizing materials are then added to the tabular cost. The depth of the required stabilizing materials does not provide a limitation to the use of tabular IAM calculation methods.

Table 12-1 includes the all-found costs for the supply, loading, transport, placement and compaction of the stabilizing material based on the distance to the material source and the average road grade.

Table 12-2 is used when crushing or screening of rock or gravel is required. If a quarry is developed for the production of rock, Table 12-4 is used for all costs associated with producing the required rock volume.

Table 12-3 is used for the supply and installation of geotextiles or geo-grids as part of subgrade stabilization.

Table 12-1. Transportation, Placement and Compaction Cost for Additional Stabilizing Material.

Additional Stabilizing Cost (\$/bm ³) All-found Cost for Supply ⁺⁺ , Transport, Place and Compact 2001 cost base				
	Haul Distance from Stabilizing Material Source (km)			
Road Grade* (Average %)	0 - 1	1 - 2	2-3	3-4
0 - 5	\$5.50	\$6.47	\$7.50	\$8.60
>5 - 10	\$6.80	\$7.97	\$9.05	\$10.15
>10 - 15	\$8.36	\$9.76	\$10.85	\$12.00
>15 - 20	\$10.23	\$11.91	\$13.15	\$14.20

⁺⁺ Supply includes all costs associated with pit development and reclamation.

* Road grade may be adverse or favourable. It is the average road grade from the midpoint of construction to the spoil area.

Table 12-2. Processing Costs for Additional Stabilizing Materials.

Material Processing Costs All-found costs for Supply 2001 cost base	
Crushing - Rock or Gravel	\$4.25/m ³
Screening - Rock or Gravel	\$3.50/m ³

Table 12-3. Supply Costs for Special Materials Costs for Additional Stabilizing.

Special Material Costs All-found costs for Supply, Transportation and Installation 2001 cost base	
Geotextiles – Non-woven and woven	\$2.10/m ²
Geogrids	\$2.50/m ²

Table 12-4. Quarry Development Costs.

<i>Quarry Development Cost (\$/bm³)</i> <i>All found cost for Site Prep, Drill and Blast *</i> <i>2001 cost base</i>	
Rock Volume (m³)	Unit Cost per bm³
> 1000m³	\$7.00
< 1000m³	\$7.00

* Includes grubbing, access costs for drill, all supplies, equipment and labour.

**ITEM 13:
RETAINING WALLS, RAILWAY CROSSINGS AND
OTHER SPECIAL STRUCTURES**

13.0 Statement

Retaining walls, railway crossings and other special structures (may include multiple culverts, baffled culverts, arched culverts and other structures determined by the timber pricing co-ordinator).

13.1 Definition

In addition to retaining walls and railway crossings, the costs for the design and construction of other special structures may be allowed under this ECE item. A list of special structures will be maintained by the Regional Timber Pricing Co-ordinator and amended from time to time as required. The current list of other approved special structures is contained in Table 13-1 below.

Table 13-1. List of Other Approved Special Structures.

- | |
|---|
| <ul style="list-style-type: none">• Arched Culverts (Bottomless Culverts)• Corrugated box culverts• Structural plate arch culverts• Structural plate pipe arch structures• Culverts manufactured with baffles• Culverts to be installed with either cast-in-place headwalls, pre-cast headwalls, reinforced earth headwalls, or corrugated steel plate headwalls• Reinforced earth/soil systems for retaining walls and road embankments• Embedded culverts that meet the requirements of the Fish Stream Crossing Guidebook |
|---|

Special structures do not include those structures specifically identified as tabular in the IAM. These tabular structures include culverts with an equivalent diameter up to 950 mm, wooden box culverts, log stringer bridges, cattle guards, fencing, and pipeline crossings.

13.2 Application

Special structures are employed where site conditions require their use and other more conventional methods or structures are not adequate or are cost prohibitive. The list of approved special structures require varied levels of professional engineering; however, all special structures require basic plans and details to preclude the use of a tabular or other structure or method.

13.3 Submission Requirements

The proponent will provide the following information where required to support an ECE for special structures:

- Rationale for the use of a special structure;
- For retaining walls and reinforced soil systems, a geometric road design and a detailed design for the proposed structure;
- For railway crossings, copies of any crossing plan, any documentation from the rail authority including certification, and invoices for work by rail authority;
- For stream crossing structures, a site plan and general arrangement (see ECE Item 11 for content requirements);
- For all embedded culverts regardless of culvert diameter, a detailed design indicating level of embedment and volumes of materials required to meet Fish Stream Crossing Guidebook;
- Volume calculations, by soil type, and mass haul diagrams;
- List of required materials and components;
- Location of borrow pits, gravel pits, rock quarries and/or waste sites;
- Construction equipment to be employed; and
- Any professional prescription completed which substantiates the requirement for a special structure.

13.4 ECE Determination

The ECE may be determined by either a detailed ECE calculation or through a public tender as outlined in Section B.1 of the Procedures. The ECE will be volume based (bank m³) for the earthworks portion(s) with the volume calculations shown on the design submitted with the ECE.

13.4.1 Railway Crossings

For railway crossings, the ECE will include the costs for the installation of the crossing, however, the cost for the road subgrade will be included in the tabular Subgrade Cost Estimate (section 4.3.2.3 of the IAM) unless it qualifies under another ECE item. The ECE may include costs for the following:

- Production of a site plan and crossing design where required by the rail authority;
- Purchase cost of structure crossing components, including signs;
- Transportation (freight) for materials;
- Safety personnel as required for the rail authority; and
- Installation of the crossing components.

13.4.2 Retaining Walls and Reinforced Soil Systems

The ECE for retaining walls and reinforced soil systems may include all costs associated with the design, purchase, transportation and installation of the structure to the final subgrade stage. The ECE may include costs for the following:

- Production of a geometric road design including the design for the structure;
- Purchase cost of structure components;
- Transportation (freight) for materials;
- Mobilization and demobilization of specialized equipment;
- Site preparation;
- Supply, placement and compaction of foundation and structural fill (volumes as per design);
- Labour and equipment costs for installation of structure components;
- Supply, placement of general fill for road subgrade (volume as per design);
- Supply and installation of any roadside barriers, hazard markers or required signage, and
- Supervision by a Professional Engineer (complex structures only).

13.4.3 Other Special Structures

The ECE for the remaining Special Structures in Table 13-1 may include all costs associated with the design, purchase, transportation and installation of the structure to the final sub-grade stage. The ECE may include costs for the following:

- Production of a site plan and general arrangement;
- Purchase cost of structure components;
- Transportation (freight) for materials;
- Mobilization and demobilization of specialized equipment;
- Site preparation;
- Temporary creek diversion, if required;
- Supply, placement and compaction of foundation (volume as per design);
- Supply, placement and compaction of structural fill envelope (volume as per design);
- Supply and placement of general fill for road subgrade (volume as per design);
- Supply and placement of rip rap or scour protection (volumes as per design);
- Supply and installation of any roadside barriers, hazard markers or required signage, and
- Supervision by a Professional Engineer (complex structures only).

ATTACHMENT

Supervision and certification cost estimates approved for use in engineered cost estimates - Northern Interior Forest Region

Supervision of Construction

The IAM, Section 4.3.3, provides for inclusion of costs related to supervision of complex structures construction by a Professional Engineer. Structures which qualify for consideration as complex are listed in Table 1 below.

The general supervision of simple structures is not an allowable cost estimate in an ECE, regardless of whether the supervision is by a professional or non-professional. The list in Table 2 includes structures which are considered to be simple, therefore not eligible for supervision cost estimate in ECEs and appraisals.

This is not to imply that supervision of simple structures is not required. The distinctions between simple and complex structures are made solely to determine eligibility for inclusion of costs for supervision within ECEs and appraisals.

The items listed in Tables 1 and 2 are not an exhaustive list. If an interpretation of what is considered complex is required, please contact the Regional Timber Pricing Coordinator.

Table 1. List of Structures Considered Complex for the Purposes of Inclusion of Costs of Supervision by Professional Engineers in ECEs and appraisals.

<ul style="list-style-type: none">• Composite concrete bridges (the deck is a structural component of the girders).
<ul style="list-style-type: none">• Multiple span bridges: simple span and continuous.
<ul style="list-style-type: none">• Major culverts (>1800mm in diameter or with flows >6m³/sec). Density testing of the compacted structural backfill must be completed using standardized testing methods. The results of these tests, including testing methodology, must be retained and available for certification. The extent of structural backfill and the specifications (including minimum density requirements) must be shown on the design drawings.
<ul style="list-style-type: none">• Non-composite bridges with spans greater than 24 metres (bearing to bearing) and/or an abutment height (above ground) greater than 5.4 metres.
<ul style="list-style-type: none">• Bridges comprised of pre-stressed and post-tensioned concrete beams and girders.
<ul style="list-style-type: none">• Any structure that incorporates a bolted or welded field splice in the girders.
<ul style="list-style-type: none">• Any structure placed on piles, or not identified in the Simple Structures listed below.
<ul style="list-style-type: none">• Any structure not identified as a Simple Structure (in these procedures).
<ul style="list-style-type: none">• Complex road structures are limited to road sections that require a Qualified Registered Professional for a design. This would be limited to retaining walls, earth retention systems, soil reinforcement systems, or special construction methods for areas where a Terrain Stability Field Assessment is required. Gravel or rock berm walls do not fall under the definition of a retaining wall or elaborate construction; these are usually a slope stabilizing solution.

Table 2. List of Structures which are considered Simple, and therefore ineligible for inclusion of supervision costs in ECEs and appraisals.

<ul style="list-style-type: none"> • Tabular structures, including culverts $\leq 1800\text{mm}$ in diameter or $< 6\text{m}^3/\text{sec}$ design flow
<ul style="list-style-type: none"> • Single span non-composite structures up to and including 24 metres in length (bearing to bearing) for both wood and concrete decks
<ul style="list-style-type: none"> • Non pre-stressed concrete slab bridges
<ul style="list-style-type: none"> • Abutment systems constructed of any of the following: <ul style="list-style-type: none"> ➤ Lock block walls up to two courses high under the pile cap or girders ➤ Log cribs up to 5.4 metres high ➤ Bin wall structures up to four courses in height ➤ Pre-cast pad and pipe footings ➤ Log, mud sills or concrete sleepers

Definition of Supervision and Certification Cost Estimates:

Supervision

The IAM allows a cost estimate for a Professional Engineer for the supervision of complex structures and the certification of bridges only.

Supervision of a structure includes the general supervision of the construction for those structures or components that are identified as complex in Table 1. Visits by a Professional Engineer for certification are to verify those critical aspects of the construction are in general conformance to the design. This would include inspection of subsurface components such as footings, structural fill, bridge components, bridge elevation and alignment, and construction of the bridge.

The supervision of complex structures is not constrained to a maximum number of days, but will be based on the project size, project components and complexity. The number of days allowed for supervision will be for only those portions of the project that requires supervision by a Professional Engineer as opposed to general project supervision. If requested by district or regional staff, the proponent must provide documentation to justify the number of days estimated for supervision or certification.

Bridge Certification:

Certification of bridges at the time of fabrication is an eligible ECE item. For bridges which are designed for re-use, this cost estimate would be included on the first installation, as part of the bridge purchase cost, and not included on re-use.

Certification of installed bridges by a Professional Engineer is restricted by the IAM to a maximum of three field trips unless otherwise approved by the Regional Timber Pricing Coordinator. Request for additional field trips should be made through the District Engineering Officer who will forward the request to the Regional Timber Pricing Coordinator. The length and number of trips should coincide with the project phases that must be viewed by a Professional Engineer to certify the bridge to the design. The

certification cost estimate may include additional office time for the completion of the report or as-built drawings as dictated by the project.

Bridge Definitions

For the purposes of defining complex versus simple structures, the following bridge definitions are provided for clarification. They are meant to distinguish between structures or individual components for the purposes of these procedures only.

Abutment Height: Measurement taken as the difference in elevation from the existing ground line to the soffit elevation (underside of girders).

Non-composite Bridge: Bridge constructed with steel girders with either timber or concrete decks. In the case of a concrete deck, the deck can be bolted, clipped or pocket grouted to the girders. The deck on a non-composite bridge does not act as a load-sharing member; the vehicle loading is completely supported by the girders.

Composite Bridge: Constructed of steel or concrete girders with steel or concrete decks. Visually, they look much like a non-composite bridge, except that the girders are usually smaller. In a composite bridge, the deck is continuous with individual panels welded or grouted to each other. In addition, the deck is intimately connected to the girders. Only Professional Engineers are permitted to design composite bridges.

Concrete Slab Girder Bridge: Constructed using reinforced concrete stringers or girders. They are solid and rectangular in cross section and are usually constructed as pre-stressed members. Due to problems with cracking and weight, they are usually limited to short spans of 12 metres or less.

Pre-stressed Concrete Box Girders: Rectangular in cross-section with a hollow rectangular shape in the center. These girders are pre-stressed in a shop and are lighter than concrete slabs because of the cross-section. These girders can be up to 18 metres in length.

Pre-stressed Concrete I-girders: Pre-stressed concrete girders in the same shape as steel I-beams. A bridge constructed with pre-stressed I-girders is always considered composite. They are used for larger spans and long-term structures.

Box Girders: Bridge girders either made of steel or concrete. These are used for very large spans; they are not normally used in the forest industry.

Pre-stressed versus Post-tensioned: For pre-stressed components, the reinforcing steel is put under tension before the concrete is poured. After the concrete is cured, the tension on the steel is released and the concrete is under compression. For post-tensioned components, the concrete is poured around the cables, which are then tensioned, after the concrete has set. Bridges or deck panels of this type require re-tensioning during the lifespan of the bridge.