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# Rail *Safety*

Oversight and Expertise

## Guideline for Culvert Safety Management January 2012



Canada

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## Foreword

The objective of this Guideline is to provide railway companies with a guide for the development of their Culvert Safety Management Program (CSMP) in accordance with the *Railway Safety Management Systems Regulation (SMS)*, the *Railway Safety Act (RSA)*, and the *Track Safety Rules (TSR)*.

This Guideline is meant to promote uniformity and industry best practices with respect to the safe management of culverts and outline Transport Canada's (TC) expectations with regards to the components that should form part of a railway company's CSMP including overall design, inspection, and maintenance practices associated with culverts over which trains operate.

This Guideline is not intended to replace existing railway procedures or practices in use by railway companies. Railway companies may use alternative practices and procedures to those outlined in this Guideline, provided that they meet the intent of this Guideline. Ultimately, it is the railway company's responsibility to ensure the safety of its operation as it applies to culverts.

## Part A – General

### 0.1 – Definitions

For the purposes of this Guideline, the terms and definitions given in the *Railway Safety Act* and the *Railway Safety Management System Regulations* apply in addition to those given below:

**“culvert”** means any under-grade drainage structure that forms a passageway through an embankment that is not a railway bridge. This also includes cattle and pedestrian passageways.

**“Culvert Safety Management Program (CSMP)”** means part of an overall railway safety management system that facilitates the management of safety risks associated with culverts.

**“designate”** means a technically competent person assigned to work under the direction of a Railway Engineer.

**“professional engineer”** means a person who is authorized under a Canadian Provincial or Territorial Engineering Act to engage in the practice of professional engineering.

**“railway bridge”** means any structure with a deck, regardless of length, which supports one or more railway tracks, or any other under-grade structure with an individual span length of 10 feet or more located at such a depth that it is affected by live loads.

**“railway authority”** means the railway company responsible for the maintenance of the railway right of way.

**“railway company”** means as defined in the *Canadian Transportation Act*.

**“railway right of way”** means any land on which a line of railway is situated, including yard tracks, sidings, spurs and other track auxiliary to the line of railway.

**“structural inspection”** means a documented inspection made by a Railway Engineer or his designate to identify and record any changes, defects, or repairs. It includes measuring specific defects, verifying the general conditions of a culvert, and its surroundings in order for a Railway Engineer to be able to accurately evaluate all aspects of a culvert and determine if anything reported represents a present or potential hazard to safe railway operations.

**“visual inspection”** means an inspection, that may or may not be documented, made in accordance with railway authority’s CSMP.

## **0.2 – Scope**

This Guideline has been developed to assist a railway company in formulating a CSMP that will conform to the following:

- *Railway Safety Act (RSA)*;
- *Guidelines – Engineering Work Relating to Railway Works (Section 11 – Railway Safety Act)*;
- *Railway Safety Management System Regulations (SMS)*; and
- *Track Safety Rules (TSR)*.

It will assist a railway company in order for it to:

- a. Establish a CSMP that identifies and mitigates, to the extent possible, hazards to users and other parties who may be exposed to risks associated with culverts and related activities;
- b. Implement, maintain and continually improve a CSMP; and
- c. Determine and assess compliance with all legislative requirements and internal practices, procedures and instructions relating to safe railway operations as it applies to culverts.

## **0.3 – Application**

This Guideline applies to a railway company to which the *Railway Safety Act* applies.

## **0.4 – Responsibility**

The railway authority is responsible for the condition of the culverts over which it or other railway companies operate trains regardless of any agreements, division of ownership or maintenance expense. The railway authority shall<sup>1</sup>, ensure that the track is being adequately supported and shall<sup>2</sup> be able to control, and restrict if necessary, the movement of trains on its segment of track, including the track over a culvert.

For culverts that the railway authority is responsible for with respect to inspection, evaluation, and repairs, the railway authority shall<sup>3</sup> ensure safe railway operations are being maintained.

If a railway authority, to which this part applies, assigns responsibility for the track and culverts to another railway company, by lease or otherwise, written notification of the assignment should be provided to the appropriate TC Rail Safety Regional Office within 30 days following the assignment. The notification should be in writing and include the following:

- a. The name and address of the railway authority that is assigning responsibility;
- b. The name and address of the railway company to whom responsibility is assigned, (assignee);
- c. A statement of the exact relationship between the railway authority and the assignee; and
- d. A precise identification of the track segment.

## **Part B – Culvert Safety Assurance**

### **1.1 – Safety Management Systems (SMS)**

Under the *Railway SMS Regulations*, a railway company is required to implement and maintain systems to manage the safety of all aspects of railway operations. The CSMP shall<sup>4</sup> form part of and be referenced in the railway company's SMS.

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<sup>1</sup> Track Safety Rules part I 6

<sup>2</sup> Track Safety Rules part I 6

<sup>3</sup> Section 11 of the Railway Safety Act

<sup>4</sup> Section 2 of the Railway Safety Management System Regulations

## **Part C – Qualifications and Designation of Responsible Persons**

### **2.1 – Scope**

A railway authority's CSMP shall<sup>5</sup> describe the qualification, training and designation of persons who perform safety critical functions that affect the integrity and safety of culverts.

### **2.2 – Culvert Safety Management Responsibility**

A railway company's CSMP shall<sup>6</sup> identify clear authorities, responsibilities, and accountabilities for the management of culvert safety.

### **2.3 – Railway Engineer**

A Railway Engineer is a professional engineer, designated by a railway authority, who is responsible for, and has related experience in the following functions as they apply to the particular engineering work to be performed:

- a. Determine the forces and stresses in culverts;
- b. Prescribe safe loading conditions for culverts;
- c. Prescribe inspection, maintenance, repair and modification procedures for culverts;
- d. Prepare designs and specifications for the repairs, modifications, replacement, or installation of culverts; and
- e. Perform hydrological and hydraulic analysis.

A Railway Engineer shall<sup>7</sup> decide to which extent professional engineers shall<sup>8</sup> be directly involved in the engineering work related to culverts.

A Railway Engineer should be authorized to restrict the operation of traffic according to the immediate condition or state of repair of a culvert.

### **2.4 – Culvert Inspector**

A Culvert Inspector is a person who is designated by a railway authority, and deemed to be technically competent to view, measure, report, and record the condition of a culvert along with its surroundings under the direction of the Railway Engineer.

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<sup>5</sup> Section 2(h) Railway Safety Management System Regulations

<sup>6</sup> Section 4(1)(e) Railway Safety Management System Regulations

<sup>7</sup> Section 11 of the Railway Safety Act

<sup>8</sup> Section 11 of the Railway Safety Act

A Culvert Inspector should be authorized to restrict the operation of traffic according to the immediate condition or state of repair of a culvert.

## **2.5 – Designation of Individuals**

Each railway authority's CSMP should designate individuals or class of individuals qualified as Railway Engineers and Culvert Inspectors. For each class of individuals designated, the records should include the basis for the designation in effect.

## **Part D – Culvert Design**

### **3.1 – Scope**

Each railway authority's CSMP should include requirements to ensure that culverts are sized to accommodate the normal flows, and that they have sufficient structural capacity to handle the applied loads.

### **3.2 – Design and Installation of New Culverts**

Each railway authority's CSMP should specify procedures for the design and installation of new culverts. The culvert design and specifications shall<sup>9</sup> be prepared under the direction of a Railway Engineer considering site requirements and using appropriate engineering methods and standards. A Railway Engineer or his designate should ensure that the work is completed in conformity with the design and specifications.

### **3.3 – Replacement and Repair of Existing Culverts**

Each railway authority's CSMP should specify procedures for assessing the structural and hydraulic adequacy of existing culverts when signs of distress are observed or where they regularly show an inability to handle normal flows.

Before replacing or repairing an existing culvert consideration should be given, by a Railway Engineer or his designate to its design flow and determine its adequacy when considering available repair or replacement options. Consideration should always be given to inlet and outlet improvements to address any increased scour potential as a result of a culvert repair or replacement.

A procedure for assessing the requirement for culverts that are not found should be developed. Assessments shall<sup>10</sup> be performed under the direction of a Railway Engineer or his designate and the results should be documented.

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<sup>9</sup> Section 11 Railway Safety Act

<sup>10</sup> Section 11 Railway Safety Act

## **Part E – Culvert Inspection**

### **4.1 – Scope**

Each railway authority's CSMP should provide for an effective culvert inspection program.

A railway authority's CSMP should clearly define the different types of culvert inspections to be undertaken, including the frequencies of these inspections.

### **4.2 – Culvert Inventory**

Each railway authority's CSMP should include an inventory of all culverts over which trains operate and at a minimum, include the following information:

- a. Location (i.e. subdivision and mileage);
- b. Number of tracks;
- c. Culvert type;
- d. Culvert Dimensions (i.e. span, rise, and number of cells);
- e. Total length;
- f. Height of Cover (measured from the top of the culvert to the bottom of tie);
- g. Year installed, if available;
- h. Geo-referenced coordinates (i.e. longitude, latitude); and
- i. Type of crossing (i.e. stream, pedestrian walkway, cattle pass etc.).

### **4.3 – Scheduling of Culvert Inspections**

In addition to visual inspection requirements of culverts contained in the Track Safety Rules, a railway authority shall<sup>11</sup> have a CSMP that:

- a. Should include a documented structural inspection at a minimum of once every five years. Should any culvert inspection indicate that the culvert is at a minimum acceptable condition (advance deterioration evident but still functioning as intended), the culvert should be scheduled for a more frequent visual documented inspection, as determine by a Railway Engineer; and
- b. Should include an inspection of any culvert that has not been in railway service and has not been inspected in accordance with this section. The inspection report shall<sup>12</sup> be reviewed by a Railway Engineer prior to the resumption of railway service.

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<sup>11</sup> SMS Regulations

<sup>12</sup> Section 11 Railway Safety Act



#### **4.4 – Culvert Inspection Procedures**

- a. Each railway authority's CSMP should specify the procedure to be used for inspection of various types and sizes of culverts.
- b. The culvert inspection procedures should be specified by a Railway Engineer or his designate. The inspection procedures should incorporate the methods, means of access, and level of detail to be recorded for the various types and sizes of culverts.
- c. The culvert inspection procedures should ensure that the level of detail in the inspection procedures is appropriate for the size and configuration of the culvert and conditions found during previous inspections.
- d. The culvert inspection procedures should be designed to detect, report, and protect deteriorations and deficiencies of the culvert, the channel conditions, hydraulic capacity and the surrounding fill material before they present a hazard to safe railway operations.

#### **4.5 – Special Inspections**

Each railway authority's CSMP should include a procedure for the protection of traffic and for the inspection of any culvert that might have been damaged by an unusual event including but not limited to flood, fire, ice flows, debris flows, sub-grade instability, beaver dam failure, earthquake, derailment, and vandalism.

#### **4.6 – Submerged Culverts**

Each railway authority's CSMP should include provisions for underwater inspections to detect the deterioration of culvert components that are submerged, or where the culvert cannot be inspected due to the depth of water.

In order to provide reasonable assurance of the culvert's integrity, the railway authority should have in place an underwater inspection program that:

- Identifies the culverts to inspect;
- Includes markers for the identification of culvert locations in the field; and
- Includes a list of items to inspect, and the frequency of inspections.

Smaller diameter culverts should include documented monitoring program that includes the frequency and items to be consider, as determined by the Railway Engineer.

#### **4.7 – Inspection of Drainage Channel Conditions**

- a. Each railway authority's CSMP shall<sup>13</sup> include provisions to ensure each drainage facility or culvert under or immediately adjacent to the roadbed is maintained and kept free of obstruction, in order to accommodate expected water flow for the area concerned.

#### **4.8 – Culvert Inspection Records**

- a. Each railway authority's CSMP should keep a record of each inspection that has been performed on culverts.
- b. Each record of an inspection under the CSMP described in this part should be prepared from notes taken on the day(s) the inspection is made, supplemented with sketches and photographs as needed.
- c. Each railway authority's CSMP should specify that every culvert inspection include, as a minimum, the following information:
  1. An identification of the culvert inspected;
  2. The date (i.e. month, year) on which the inspection was completed;
  3. The identification of the inspector;
  4. The type of inspection performed;
  5. An indication on the report as to whether any item noted thereon requires a expedited or critical review by a Railway Engineer or his designate, and any restrictions placed at the time of the inspection; and
  6. The condition of components inspected, which may be in a condition-reporting format, together with any narrative description or photographs, as necessary, for the correct interpretation of the report.
- d. Each railway authority's CSMP should specify the retention period and location of culvert inspection records.

#### **4.9 – Review of Culvert Inspection Reports**

Each railway authority's CSMP should specify the manner and timeline in which culvert inspection reports are to be reviewed by a Railway Engineer, or his designate, to:

- a. Determine whether inspections have been performed in accordance with the relevant schedule and specified procedures;
- b. Evaluate whether any items on the report represent a present or potential hazard to safe railway operations;
- c. Require any modifications to the inspection procedures or frequency for that particular culvert; and
- d. Schedule any repairs or modifications to the culvert that are required to maintain its structural integrity and hydraulic capacity.

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<sup>13</sup> Track Safety Rules part II B.I

- e. Ensure that inspection reports are reviewed in accordance with the timeline identified in the railway authority's CSMP.

#### **4.10 – Culvert Hazard Identification and Risk Assessment**

Railway companies are required to implement and maintain processes for the identification of safety issues and concerns,<sup>14</sup> evaluating and classifying risks by means of a risk assessment<sup>15</sup>, and implement necessary risk control strategies<sup>16</sup>.

### **Part F – Requirements of Section 11 – *Railway Safety Act***

#### **5.1 – Scope**

Pursuant to Section 11 of the *Railway Safety Act* “All engineering work relating to railway works, including design, construction, evaluation or alteration, shall be done in accordance with sound engineering principles. A professional engineer shall take responsibility for the engineering work”.

#### **5.2 – Engineering work related to Culverts**

Engineering work includes but is not limited to:

- Culvert design;
- Installation and maintenance procedures;
- Inspection and review procedures;
- Deferred maintenance procedures;
- Procedure for maintenance and replacement work completed; and
- Hydrological and hydraulics analysis.

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<sup>14</sup> Section 2(e)(i) of Safety Management System Regulations

<sup>15</sup> Section 2(e)(ii) of Safety Management System Regulations

<sup>16</sup> Section 2(f) of Safety Management System Regulations

## **Part G – Documentation, Records and Audit of Culvert Safety Management Programs**

### **6.1 – Scope**

Each railway authority's CSMP should include a process for the verification of the effectiveness of the program and the accuracy of the resulting information.

### **6.2 – Audits, General**

A Railway company shall<sup>17</sup> implement and maintain procedures for periodic internal safety audits, reviews by management, monitoring, and evaluations of its CSMP to determine whether it:

- a. Meets the requirements of this Guideline;
- b. Has been properly implemented and maintained; and
- c. Is effective in continually reducing the risk associated with culverts.

### **6.3 – Documents and Data Management**

Each railway authority should document their CSMP and keep records under this part. The CSMP documents and records should be made available to Transport Canada, in Canada, upon request, as soon as reasonably practicable.

The railway authority should retain, where possible, pertinent drawings for as long as they are responsible/own the culvert and inspection records as per Section 4.8 of this Guideline.

When maintenance responsibilities for track and culverts are assigned to another railway company, it should be assigned or given access to pertinent culvert documents and drawings.

### **6.4 – Electronic Record Keeping**

A railway authority should make it known to Transport Canada, upon request, whether they are maintaining paper or electronic records, or a combination thereof.

A railway authority may create and maintain any of the records required by this part through electronic storage. To qualify as electronic storage the following conditions should be met:

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<sup>17</sup> Section 2(J) of the Safety Management System Regulations

1. The system used to generate the electronic record meets all requirements of this part;
2. The electronically generated record contains the information required by this part;
3. The railway authority should train its employees who use the system on the proper use of the electronic record keeping system; and
4. The railway authority maintains an information technology security program adequate to ensure the integrity of the system, including the prevention of unauthorized access to the program logic or individual records.