Proposed Code of Practice for the Reduction of Volatile Organic Compound (VOC) Emissions from the Use of Cutback and Emulsified Asphalt

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Preface

Asphalt use in Canada and VOC emissions

Canada has approximately one million kilometers of roads and highways, of which just under half are paved. With more than 20 million road vehicles registered in Canada, the transportation system also includes large areas of parking lots and private driveways. Asphalt is the material of choice for road and parking lot pavement. It is used for construction, maintenance and repairs. With such a large paved surface across Canada, the asphalt sector (manufacturing, distribution, supply and use) is an important industry sector in Canada.

Emulsified asphalt and cutback asphalt are used for various applications associated with road construction, maintenance and repairs. Examples include:

- Plant mix (open-graded, dense-graded, sand);
- Road mix (mixed in place), including mining with open- and dense-graded aggregate, sand, sandy soil;
- Surface treatment, including fog, sand, chip, sandwich, and slurry seals, micro-surfacing and cape seal;
- Asphalt applications including prime and tack coat, dust palliative, crack filler;
- Maintenance mix;
- Cold in-place recycling; and
- Full-depth reclamation.

In preparing these products, asphalt cement is mixed with either a petroleum diluent, to produce cutback asphalt or with emulsifiers, water and sometimes a small quantity of petroleum diluent, to produce emulsified asphalt. Once the liquefied asphalt cement is applied to the surface of the road, the diluent (petroleum solvent in the case of asphalt cutbacks and primarily water in the case of asphalt emulsions) evaporates, leaving the residual asphalt cement to perform its function.

The application of asphalt causes emissions of VOC through the evaporation process described above and contributes to the creation of ground-level ozone and particulate matter, which are major components of smog.

As of 2015, many jurisdictions in Canada and in the United States have adopted practices to control the level of VOC emissions from this sector. All of these jurisdictions include restrictions of cutback asphalt during the ozone season, which is typically the summer months, while many also include restrictions of VOC content in manufacturing of both products. Some jurisdictions also prohibit cutback asphalt throughout the year.

The level of VOC emissions depends on a number of factors, including the type of asphalt used and the ambient temperature. New formulations of asphalt using bio-products instead of petroleum solvents are being developed and are becoming more available. The hardening of this type of asphalt is done through polymerization of the bio-diluent rather than through evaporation, thereby eliminating VOC emissions.

The majority of asphalt used in Canada is the emulsified asphalt type. Based on a study conducted for Environment Canada in 2010, 301 kilotonnes (kt) of liquefied asphalt were used in Canada in 2009, 85 percent of which was emulsified asphalt while 15 percent was cutback.
The total VOC emissions associated with this usage are estimated to be 8.8 kt (5.2 kt for cutback asphalt and 3.6 kt for emulsified asphalt). While cutback asphalt represented only 15 percent of asphalt use in Canada in 2009, it was responsible for 59 percent of the VOC emissions associated with the use of asphalt. The same study estimated that VOC emissions from asphalt could reach 10.8 kt in 2020 in the absence of an environmental framework to guide the use of asphalt in Canada.

**Air quality issue**

Smog is an air quality issue that poses serious health and environmental concerns in Canada. Particulate matter and ground-level ozone are the two principal components that comprise smog. Particulate matter and ozone can be transported by prevailing winds over long distances, making them not only a local urban issue but one that also extends regionally in Canada into many smaller communities and rural areas.

Ozone is formed by complex reactions between the precursor emissions, i.e. nitrogen oxides (NOx) and VOCs, in the presence of sunlight. Particulate matter is released directly into the air by industrial activity, and it is also formed in the atmosphere via complex chemical reactions involving the emissions of smog precursors, including sulphur dioxide (SO2), NOx, VOC and ammonia (NH3). In order to reduce smog levels and improve air quality, it is necessary to control and reduce the direct particulate matter and the precursor emissions of SO2, NOx, VOC and NH3.

On July 2, 2003, an Order added ozone and particulate matter precursors to Schedule 1 (List of Toxic Substances) of the *Canadian Environmental Protection Act, 1999* (CEPA 1999). Along with gaseous ammonia, nitric oxide, nitrogen dioxide and sulphur dioxide, VOCs were added to Schedule 1 due to their role as precursors in the formation of ground-level ozone and particulate matter. The addition of the precursors enables the Government of Canada to regulate, under CEPA 1999, VOC emissions contributing to PM and ozone.

The Canadian Smog Science Assessment (co-authored by Environment Canada and Health Canada) of 2012 concluded that both particulate matter and ground-level ozone (two of the main components of smog) need to be treated as having no safe level.

**Objective**

The main objective of the proposed *Code of Practice for the Reduction of Volatile Organic Compound (VOC) Emissions from the Use of Cutback and Emulsified Asphalt* (Code) is to ensure that the environment and health of Canadians is protected while maintaining road safety. Consequently, the intent of the Code is to provide guidance to the asphalt sector regarding actions that can contribute to the reduction of VOC emissions from the use of cutback asphalt and emulsified asphalt in order to reduce health and environmental concerns in Canada. The potential reduction in current VOC emissions from the use of cutback asphalt is estimated to be between three and five kilotonnes on an annual basis.

The Code aims to reduce VOC emissions from that sector by 55 percent over a five-year period. This assessment will be calculated by comparing the correlation between the total quantities of cutback asphalt manufactured during the five-year period with the initial quantity of asphalt manufactured.
cutback manufactured in the year of publication of the Code. This evaluation will help determine if amendments to the Code or the development of any other control instrument is required to better manage VOC emissions from the asphalt sector.

**Additional benefits**

Applying the standards and operating practices outlined in the Code may also achieve the benefits described below.

- The Code could set national standards and best practices across Canada, fostering consistency and alignment with similar measures in other jurisdictions in North America.
- Reductions in VOC emissions resulting from actions taken according to the Code will generate environmental and health benefits in reducing the intensity and frequency of smog events.
- Following the measures described in the Code will also improve air quality at the site of application of asphalt, reducing the potential health impact on workers and local communities, especially in urban centres.

**1-Interpretation**

**1.1-Applicability**

The Code applies to any person or organization involved in the production, sale, purchase or use of cutback asphalt or emulsified asphalt. This includes:

1. Private sector manufacturers;
2. Procurement enablers (governments and private sector); and
3. Private sector end-users (paving companies).

**1.2-Definitions**

The following definitions apply to this Code:

**Asphalt cement:** a dark brown to black cement-like residuum obtained from the distillation of suitable crude oils. The distillation process may involve one or more of the following: atmospheric distillation, vacuum distillation, steam distillation. Further processing of distillation residuum may be needed to yield a material whose physical properties are suitable for commercial applications. The additional processes can involve air oxidation, solvent stripping or blending of residua of different stiffness characteristics.

**ASTM:** means American Society of Testing and Materials.

**Crude oil:** unrefined petroleum product composed of hydrocarbon deposits. For the purpose of

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the Code, these will have the meaning of cutback asphalts such that any use of crude oil in a cutback asphalt application falls within the scope of this Code.

**Cutback asphalt**: asphalt cement whose viscosity has been reduced by the addition of a cutback solvent derived from petroleum. There are three major types of cutback asphalt based on the relative rate of evaporation of the solvent: rapid-curing, medium-curing and slow-curing.

Cutback asphalts are classified into three groups depending on the relative speed of evaporation:

- **Rapid-curing**: asphalt cement combined with a light petroleum diluent of high volatility, generally with a boiling point similar to gasoline or naphtha and as further defined by ASTM D2028 / D2028M “Standard Specification for Cutback Asphalt (Rapid-Curing Type)”.

- **Medium-curing**: asphalt cement combined with a petroleum diluent of intermediate volatility, generally with a boiling point similar to kerosene and as further defined by ASTM D2027 / D2027M “Standard Specification for Cutback Asphalt (Medium-Curing Type)”.

- **Slow-curing**: asphalt cement combined with a petroleum diluent of low volatility, generally with a boiling point similar to fuel oil and as further defined by ASTM D2026 / D2026M “Standard Specification for Cutback Asphalt (Slow-Curing Type)”.

Cutback asphalts can be used with cold aggregates requiring little or no heat. They are most commonly used in road mixing operations, stockpile mixes and spray applications such as prime, tack and seal coats. For the purpose of this document, cutback asphalts also include any crude petroleum oils and road oils used for road construction and maintenance.

**Emulsified asphalt**: a mixture of asphalt cement, water and an emulsifying agent. There are two major categories of emulsified asphalt: cationic and anionic. Anionic emulsions have negatively charged asphalt droplets and cationic emulsions have positively charged asphalt droplets. Certain grades of emulsified asphalt contain added petroleum diluent which permits a thicker film to adhere to the aggregate and promotes stronger bonding of the asphalt to the aggregate.

Several types and grades of emulsified asphalts are produced to serve specific applications:

- The RS, MS, SS and QS designations refer to the emulsion setting rate of rapid-setting, medium-setting, slow-setting and quick-setting, respectively.

- The C preceding some of the emulsified asphalt grades designates a cationic asphalt emulsion.

- The $h$ that follows certain grades designates a harder base asphalt in the product.

- The $HF$ preceding some of the grades indicates a high-float product as measured by a float test as further defined by ASTM D139 “Standard Test Method for Float Test for Bituminous Materials”. High-float products generally contain added petroleum diluent such as fuel oil, which permits a thicker film to adhere to the aggregate and promotes
stronger bonding of the asphalt to the aggregate. HF products are often used with dusty or dense graded aggregate.

Emulsified asphalt products are used for road construction and for many specialty applications. RS and CRS products are generally used in spray applications such as aggregate (chip) seals and other surface treatment methods. The medium-setting grades are more commonly used for mixing with coarse aggregate for plant or road mix. The slow-setting grades are designed for maximum mixing stability and are used with dense-graded aggregate containing high fines which are used in soil stabilization, asphalt surface mixes, slurry seal applications, and tack and prime coat applications. Quick-setting grades are specialized emulsions used for quick-set slurry applications.

**Governments:** all orders of government, municipal, regional, provincial, territorial, federal and Aboriginal authorities may be proponents of paving projects.

**The Minister:** the Minister of Environment and Climate Change.

**Ozone season:** the ground-level ozone season occurs during the warm-season months, when the days are warmer and longer. The period of May 1 through September 30 is considered the ground-level ozone season in Canada, as defined in the Ozone Annex (2000) of the Canada-United States Air Quality Agreement (1991).

**Road oils:** for the purpose of the Code these will have the meaning of cutback asphalts such that any use of crude oil in a cutback asphalt application falls within the scope of this code.


### 2-General Recommended Practices

#### 2.1-Cutback asphalt

#### 2.1.1-Practices regarding cutback asphalt during the ozone season

It is not recommended to sell, offer for sale, use, manufacture or import cutback asphalt in paving material, in paving, construction or in maintenance operations, of, for example, roads, streets, highways, parking lots or driveways between May 1 and September 30, that exceeds 0.5 percent of volume of VOCs which evaporates at 260°C (500°F) or less, as determined by the oil portion of the distillate collected when analyzed in accordance with ASTM D402 /D402M “Standard Test Method for Distillation of Cutback Asphalt”. This limit recognizes the use of some specialized cutback products.

#### 2.1.2-Practices regarding cutback asphalt outside of the ozone season

It is not recommended to sell, offer for sale, use, manufacture or import cutback asphalt in paving material, in paving, construction or in maintenance operations of, for example, roads, streets, highways, parking lots or driveways between October 1 and April 30, that exceeds 5 percent of volume of VOCs which evaporates at 260°C (500°F) or less, as determined by the oil
portion of the distillate collected when analyzed in accordance with ASTM D402 / D402M “Standard Test Method for Distillation of Cutback Asphalt”.

2.2-Emulsified asphalt

2.2.1-Practices regarding emulsified asphalt during the ozone season

It is not recommended to sell, offer for sale, use, manufacture or import emulsified asphalt in paving material or in paving, construction and maintenance operations of, for example, roads, streets, highways, parking lots or driveways between May 1 and September 30 that exceeds 3 percent of volume of VOCs which evaporates at 260°C (500°F) or less, as determined by the oil portion of distillate collected when analyzed in accordance with ASTM D6997 “Standard Test Method for Distillation of Emulsified Asphalt”.

2.2.2-Practices regarding emulsified asphalt outside of the ozone season

There are no recommendations on sale, use, manufacture or import of emulsified asphalt in paving material or in paving and maintenance operations of, for example, public roads, streets, highways, parking lots or driveways between October 1 and April 30.

2.3-Manufacture, import, sale and use

It is recommended that manufacturers, importers, sellers and users of cutback asphalt consider manufacturing, importing, selling or using low-emitting VOC product alternatives to replace petroleum solvents in the formulation of cutback asphalt.

2.4-Labelling

Anyone who manufactures, imports, sells or offers for sale cutback asphalt or emulsified asphalt should develop a product technical specification sheet that accompanies the product and includes seasonal recommendations on product use in Canada, in accordance with sections 2.1 and 2.2 of the Code of Practice. Reference to the Code should also be displayed.

2.5-Procurement

It is expected that proponents of projects requiring the use of cutback asphalt or emulsified asphalt be familiar with the Code.

It is recommended that commitment to follow the Code be a condition of any contract that is issued for paving or maintenance operations in Canada by any proponent or any level of government, including municipal, provincial, territorial, federal or Aboriginal authorities.
Contracts referred to in the previous paragraph should promote the use of alternative formulations of asphalt containing low VOC-emitting alternative products available that meet the specifications for the contract, when appropriate.

2.6-Conditions of use and training of staff

Any person or company conducting paving or maintenance operations using cutback asphalt or emulsified asphalt should conduct all of their activities in accordance with the Code.

Any such person or company should provide their employees with appropriate training on the requirements of the Code. Such training could include, as a minimum, knowledge of the type of asphalt product that should be used during and outside the ozone season, the recommended use for various types of asphalt throughout the year, the operational changes associated with the use of emulsified asphalt with lower concentrations of VOCs compared with the use of cutback asphalt with higher concentrations of petroleum solvents, and record keeping procedures.

3-Record Keeping

3.1-Manufacturers

Anyone who manufactures cutback asphalt or emulsified asphalt should keep records of the quantity and grade of all asphalt manufactured and sold for that year. These records should be kept for a minimum of six years.

3.2-Proponents of paving projects (procurement enablers)

Anyone who enters into a contractual agreement with a paving company for paving or maintenance operations with cutback asphalt or emulsified asphalt should keep a copy of such contracts for a minimum of six years.

3.3-End-users (paving companies)

Anyone who uses cutback asphalt or emulsified asphalt for paving or maintenance operations should keep records of the quantity and type of asphalt product used for each year. These records should be kept for a minimum of six years.

4-Declaration and Reporting

4.1-Declaration
A person that is targeted by the Code should indicate in writing to the Minister no later than six months after its coming into effect, its intention to implement the Code and should include the information specified in the form provided in the Appendix.

4.2-Annual reporting

A person who meets the conditions of section 3.1 should send annual reports to the Minister. The first report should be sent, at the latest, six months after its coming into effect and should cover the previous year’s activities. Subsequent reports should be sent annually to the Minister by March 31 on the following year.

The report sent in by manufacturers should contain the type of asphalt product, quantity manufactured (kg), quantity sold (kg), percent by volume of VOCs and province of use of cutback asphalt and emulsified asphalt. The report could also contain information on specific actions implemented to reduce the quantity of cutback asphalt used each year. These actions may be contained in the Code or may be developed by the facility. The date at which these actions were initiated at the facility should also be recorded.

A person who cannot implement the general recommended practices of the Code should provide an explanation as to why reductions in the manufacture and/or sales could not be achieved.

This information will be used to evaluate and determine whether the objectives of the Code were achieved in reducing the emissions of VOC from the asphalt sector.

5-Review of Progress

The Minister will review the implementation of the Code after five years. The review will determine the level of implementation of the best management practices recommended by the Code. The information collected through annual reporting will help determine whether amendments to the Code or the development of any other control instrument is required or whether the Code has met its objectives of reducing the VOC emissions from this sector.

6-Coming into Effect

The Code will come into effect on the day that the Notice announcing the availability of the final Code is published in the Canada Gazette, Part I.

7-Contact information

Mail: Products Division
      Environment and Climate Change Canada
      351, St-Joseph Blvd., 9th floor
      Gatineau, Quebec
      K1A 0H3
Proposed Code of Practice for the Reduction of Volatile Organic Compound (VOC) Emissions from the Use of Cutback and Emulsified Asphalt

Telephone: 819-938-4483 or 1-888-391-3426
Fax: 819-938-4480 or 1-888-391-3695
Email: ec.produits-products.ec@canada.ca
Appendix:

Declaration Form
Information to be enclosed in the declaration

<table>
<thead>
<tr>
<th>Section 1 – General information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name (company):</td>
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<tr>
<td>Telephone number:</td>
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<tr>
<td>Civic and postal addresses:</td>
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<td>Fax number:</td>
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<td>Email address:</td>
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<td>Telephone number:</td>
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<td>Civic and postal addresses:</td>
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<td>Fax number:</td>
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<td>Email address:</td>
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<tr>
<th>Section 2 – Declaration of intention</th>
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<tbody>
<tr>
<td>It is our company’s intention to implement the Code.</td>
</tr>
</tbody>
</table>

I declare that this information is accurate and complete.

_________________________  ___________________________
Date                        Signature
Annual Report Form

Information to be enclosed in the annual report

Section 1 – General information

Name (company): ___________________________ Telephone number: ___________________________
Civic and postal addresses: __________________ Fax number: ___________________________
Email address: _____________________________ _____________________________
Name and title of the contact: __________________ Telephone number: ___________________________
Civic and postal addresses: __________________ Fax number: ___________________________
Email address: _____________________________ _____________________________

Section 2 – Information with respect to the asphalt products manufactured and sold

Calendar year: _____________________________

<table>
<thead>
<tr>
<th>Type of asphalt</th>
<th>Ozone season (Y/N)</th>
<th>Quantity manufactured (kg)</th>
<th>Quantity sold (kg)</th>
<th>% by volume of VOCs</th>
<th>Province</th>
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For Environment and Climate Change Canada use
Section 3 – Supplementary information

☐ I am enclosing a rationalization to explain why there is no technically or economically feasible way to reduce the VOC emissions from the product by using a lower VOC-emitting alternative product, such as emulsified asphalt.

☐ I am enclosing a description of specific actions implemented to reduce the quantity of cutback asphalt manufactured.

☐ I am enclosing a rationalization to explain why reductions in manufacture and/or sales of cutback asphalt could not be achieved this year.

Section 4 – Confidentiality

An applicant who submits a request, in accordance with section 313 of the Canadian Environmental Protection Act, 1999, that information contained in the application be treated as confidential must include with that request the identification of the following:

a) any information that constitutes a trade secret;

b) any information the disclosure of which would likely cause material financial loss to, or prejudice the competitive position of, the applicant;

c) any information the disclosure of which would likely interfere with contractual or other negotiations being conducted by the applicant; and

d) any financial, commercial, scientific or technical information that is confidential and is treated consistently in a confidential manner by the applicant.

I declare that this information is accurate and complete.

_________________________  _________________________
Date                        Signature