During the thaw period

TRAVEL LIGHT

PROTECTING THE ROAD NETWORK: **A PRIORITY**

2025

Votre gouvernement

Québec

This publication was prepared by the Direction générale de la sécurité et du camionnage and edited by the Direction générale des communications of the Ministère des Transports et de la Mobilité durable.

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For more information, you can:
• dial 511 (in Québec) or 1-888-355-0511 (elsewhere in North America)
• visit the website of the Ministère des Transports et de la Mobilité durable at www.transports.gouv.qc.ca
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PROTECTING THE ROAD NETWORK: A PRIORITY

Every spring, the Ministère des Transports et de la Mobilité durable establishes the dates for the thaw period for the three zones that comprise the territory of Québec. During this period, heavy vehicles that travel on the road network must reduce their loads in accordance with the limits imposed by the *Vehicle Load and Size Limits Regulation* that applies to road vehicles and combinations of road vehicles.

The coming into effect of load limits because of the thaw invariably raises a number of questions concerning the load limits applied to heavy vehicles, pavements and structures, along with the effects of climate on roads, the procedure used to establish the thaw period, traffic control, etc. In order to answer some of these questions, we created this document, which contains the essential information related to these topics, as well as maps and answers to recurring questions concerning pavements and vehicle loads.

It is only logical to subject heavy transport operators to more restrictive regulations during the thaw period, especially considering that the Gouvernement du Québec invests substantial amounts annually in repairs and upgrades to its road network.

For information concerning authorized load limits during the thaw period, or concerning any other topic, choose one of the options listed below.

- Visit the website of the Ministère des Transports et de la Mobilité durable:
  www.transports.gouv.qc.ca

- Call 511 (in Québec)
  1-888-355-0511 (from anywhere in North America)

If you require information concerning road transport control, contact the information centres of the Société de l'assurance automobile du Québec.

Monday to Friday, 8:00 a.m. to 5:00 p.m.:

Ville de Québec area: **418 643-7620**
Montréal area: **514 873-7620**
Elsewhere: **1-800-361-7620** (Québec, Canada, United States)

These numbers also give you access to the automated information system, which includes a variety of services and allows you to carry out certain transactions outside of office hours.

Happy reading!

ROADS IN QUÉBEC: BACKGROUND

Roads are essential to Québec's economy, ensuring the movement of people and goods everywhere. So, regardless of its density, population size or resources, every region must be accessible via a road infrastructure. The Ministère des Transports et de la Mobilité durable has to take into account the considerable distances involved, the many waterways and the harsh, regionally variable climate when developing and maintaining this infrastructure.

The Ministère's objectives for the road network

- Make sure the network is well maintained
- Maintain efforts to improve the network
- Adapt the network to changing travel needs by maximizing use of existing infrastructure

Development work is carried out to make sure that a region's economic activity is maintained and developed, and to ensure the safety of users.

Modern and efficient road network

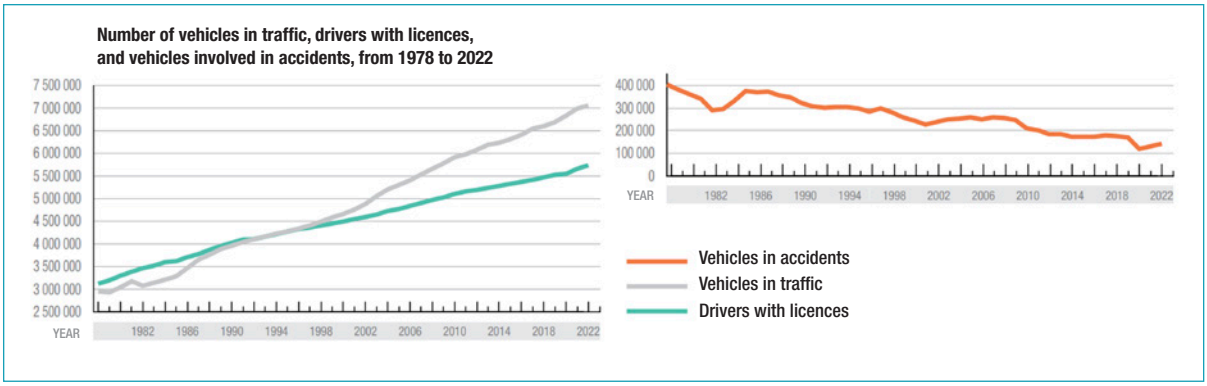
Québec's road network comprises about 325,000 km of highways. The Ministère manages about 31,000 km of highways, national roads, regional roads, and collector roads, as well as nearly 11,000 structures located on the Ministère's network and on municipal roads. Municipalities manage 107,000 km of local roads and streets. The Ministère des Ressources naturelles et des Forêts manages about 186 000 km of the network (access roads). Hydro-Québec manages around 100 km of the network. The federal government is responsible for around 500 km of the network.

The replacement value of the road infrastructure under the Ministère's responsibility, province-wide, is over $30 billion.

A steadily growing fleet

According to the Société d'assurance automobile du Québec (SAAQ), since 1978, the number of vehicles in circulation has seen an average increase of 2.0% per year. Furthermore, the number of licence holders increased by 1.4% annually, on average. As for damaged vehicles, their number shows an average decrease of 2.0% for the period from 1978 to 2022.

SAAQ data indicates that the vehicle fleet exceeded seven million vehicles in 2022, which is an increase of approximately 12% since 2015. The number of commercial vehicles increased by around 21% between 2015 and 2022.



Québec: A unique environment

The vastness of the territory, low population density, harsh climate and heavy traffic in major urban areas make Québec one of the most difficult places in the world to maintain and operate a road network. Although half the population is concentrated in the Ville de Montréal and Ville de Québec regions, the road network covers the province's entire inhabited territory.

Québec's climatic conditions are exceptionally harsh, with temperature swings of up to 25°C in just a few hours. For more than four months, the ground freezes at depths ranging from 1.2 m to 3 m, depending on the region. Precipitation (rain and snow) is abundant, reaching 1,000 mm/year. In spring, after having withstood deformation caused by deep frost, the pavement must be able to withstand significant loads; yet, during the thaw period, the strength of the pavement is reduced by 30% to 70%.

These unique conditions make it difficult to compare Québec roads with those of other countries and to import technologies before doing extensive analyses.

High priority given to research and development (R&D)

The Ministère's R&D activities are focused on traffic flow, network protection and road user safety. However, Québec's road network, built for the most part in the 1960s–1970s, is showing clear signs of aging. As a result, despite a difficult economic climate, the Ministère is faced with a large number of major maintenance and rehabilitation projects to ensure that its road network meets the needs of a growing number of users and can withstand a significant increase in heavy traffic.

The Ministère is therefore focusing on R&D to identify more efficient techniques and materials, thus safeguarding the sustainability of its structures.

This is a major shift that has allowed the development of innovative techniques, the adaptation of various technologies to the Québec context, and the design and development of new equipment.

BRIDGES: AN ESSENTIAL COMPONENT OF THE ROAD NETWORK

The structures inventory of the Ministère des Transports et de la Mobilité durable includes over 5,600 bridges under its management. Since January 2008, the Ministère has also assumed management of more than 4,200 bridges from the municipal network.

Bridges may be an obstacle for some vehicles, due to both their load limits and their vertical clearances. However, these restrictions on bridges do not depend on weather conditions; the more restrictive regulations in force during the thaw period are established for the sole protection of the roads.

The Ministère des Transports et de la Mobilité durable, through the "Trucking" section of its Québec 511 website, makes two tools available to truckers to inform them, at all times, of the restrictions on bridges.

The *Répertoire des limitations de poids* [Register of bridges with weight restrictions] contains information concerning structures that may obstruct the flow of vehicles, due to their limited load-bearing capacity. Regular inspections to detect defects, evaluations of load-bearing capacity and work performed on the bridges ensure that the situation in the field is constantly evolving: signs may be replaced, added or removed during any period of the year. Road users are therefore encouraged to consult the Répertoire before each trip.

The *Répertoire des hauteurs libres sous les ponts* [Register of vertical bridge clearances] contains data concerning the clearances measured under all road, railway or pedestrian bridges crossing roads under the Ministère's management or numbered municipal roads. The data is also provided for bridges under the Ministère's responsibility that cross unnumbered municipal roads. The data in the Répertoire may be changed after the repair or replacement of bridges or addition of new bridges in the network. The work performed on the roadways spanned by the bridges may also affect the clearance data. Consulting the Répertoire is therefore an integral part of the process to determine a transport route.

The following signs are located near bridges and overpasses that have weight restrictions.

Weight Restriction signs inform drivers of trucks* whose total loaded weight exceeds the maximum weight indicated on the signs that they are prohibited from using a bridge. These signs also apply to buses. The “X” indicates the total maximum load of a road vehicle, the “Y” indicates the total maximum load of a combination of road vehicles consisting of two units, and the “Z” indicates the total maximum load of a combination of road vehicles consisting of more than two units..

Weight Restriction signs inform drivers of all road vehicles with a total loaded weight exceeding the maximum weight that is indicated on the sign that they are prohibited from travelling on a bridge. The “X” indicates the total maximum load of a road vehicle or a combination of road vehicles.

The Legal Load Limitation sign informs drivers of vehicles that weigh more than the legal limit provided by the *Vehicle Load and Size Limits Regulation* that they are prohibited from driving on certain bridges.

Trucks Prohibited signs indicate that all truck traffic is prohibited on the road.

* The outlines on the signs refer to trucks, tow trucks and tool vehicles.

PAVEMENT DESIGN

Pavement structure is simple in appearance only, with hardly a few layers visible above the ground. In reality, pavement design depends on a number of factors, making it one of the most complex civil engineering structures.

Pavements fall into two main categories, distinguished by their mechanical behaviour and the type of material used. Rigid pavement is characterized by a concrete road surface. It reacts as a solid block, and experiences very little distortion under load. Flexible pavement, which is used more frequently in Québec, is covered with a coating commonly known as asphalt. This type of pavement experiences only slight distortion under the flow of traffic and, for all practical purposes, fully resumes its original shape afterwards.

Rigid pavement is generally well adapted to intense traffic, which is characterized by a high volume of heavy vehicles. Flexible pavement adapts well to most traffic conditions.

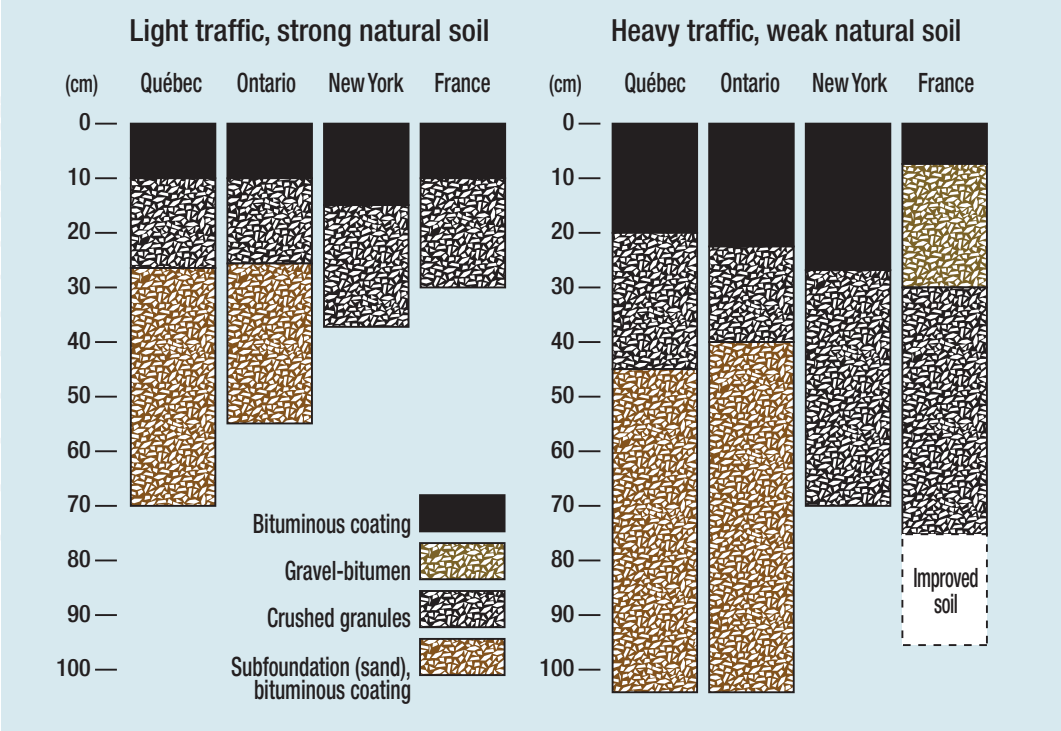
The pavement coatings help increase the structural capacity by reducing the impact of the weight that is transmitted to the underlying layers (foundation, subfoundation and ground) and limit water penetration. Layering variable thicknesses of different materials, such as sand, gravel, and crushed stone, also counters the effect of frost on the ground. The useful life of flexible pavement prior to major renovations is generally 25–30 years. The thickness and types of materials used are determined based on the type of road that is being built, traffic needs, soil characteristics, and specific weather conditions. The design method relies on a series of equations, with factors that are adapted to the Québec context, taking into consideration the following elements:

- Weather conditions (temperature, humidity). The thaw period is critical: the same truck axle can cause 5 to 8 times more damage in spring than in summer.
- The susceptibility to frost and thaw, and the mechanical properties of the soils that are present.

Once the calculations have been carried out, the loads and deformation that are liable to be transmitted to each layer are compared to the load-bearing capacity of each layer.

Heavy loads on thin layers or poorly resistant materials can cause premature cracks in the surface or permanent deformations in the pavement. For example, a 20% increase in load translates into a more than 100% increase in damage, which is why it is important to design the pavement properly and to accurately anticipate traffic growth.

The effect of frost action on road pavements can cause heaving, which directly affects the quality of the surface and reduces the pavement life cycle. An adequate thickness of materials, not too susceptible to frost, may be effective under such circumstances. The use of other pavement insulation techniques is sometimes necessary when the bearing soil deforms under the effect of frost. In the presence of variable bearing soils, the development of transitions is a common practice to ensure good pavement behaviour. Finally, the process is completed by analyzing the cost of the various options.



Shifting practices

There are significant differences between road structures in different countries. At first glance, this may seem surprising. However, these differences are inevitable, because soils, climate, traffic, materials, and costs often tend to be vastly dissimilar. Comparisons are therefore highly risky, as is importing technologies without first doing extensive analyses.

In Québec, pavement structures designed using proven design methods and parameters compare advantageously to that of other countries which are often cited as examples. Considering its unique context, and with equal traffic flow, Québec clearly ranks first in terms of the total thickness of the materials that make up its road structures.

Design methods and knowledge of pavement design are rapidly evolving, and new technologies and new products are emerging. In order to optimize the use of these new processes, and to reduce the risk of poor performance, in the 1990s, the Ministère launched a meticulous monitoring program with respect to the performance of pavements, in order to document the evolution of the behaviour of pavements in the Québec context. This innovative approach has made it possible to establish a knowledge base for optimizing design methods and interventions on the road network. A number of pilot projects conducted by the Ministère, in collaboration with specialized companies, have made it possible to define the usage potential of various pavement construction and repair techniques. The development and increasingly widespread use of techniques including the recycling of pavement materials, and thermal insulation techniques for reducing the negative effects of frost on the behaviour of pavements are examples of these projects.

THE EFFECTS OF CLIMATE ON ROAD PAVEMENTS

Although they may seem simple at first glance, road pavements are structures that cover extensive expanses of land and exhibit complex behaviour. Understanding and analyzing this behaviour is one of the greatest challenges in civil engineering.

The personality of pavement

Pavements fall into two main categories, distinguished by the type of coating used: bituminous-coated flexible pavement (asphalt), which makes up more than 90% of the road network; and rigid pavement with a concrete cement surface, which covers 4% of the network. Figure 1 illustrates a cross-section of a pavement that can accommodate both types of structures. The choice of the most appropriate pavement type and design depends on many factors, including the anticipated intensity of traffic, types of soil, climate, cost, and local availability of construction materials.

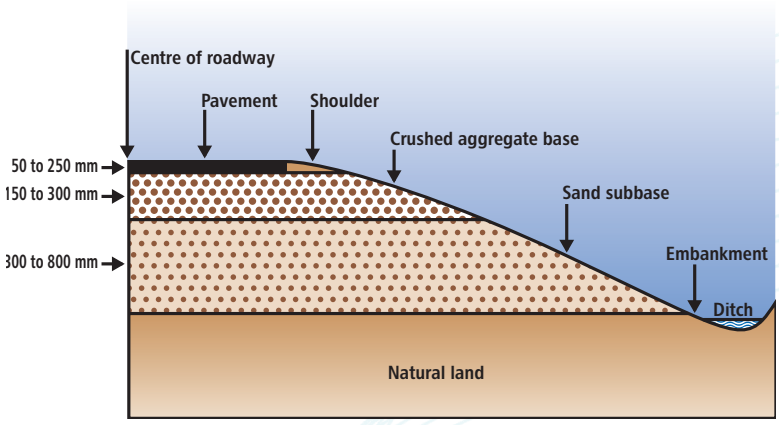


Figure 1: Example of a typical pavement section

Dynamic structures

The condition of a pavement is assessed on the basis of certain defects that become more pronounced with time and use. To describe these defects, we usually refer to the following elements:

1. Surface evenness, which is used to define the ride quality, comprises imperfections that are perceived as waves due to dips and bumps.

2. Ruts form, and the surface experiences wheel path depressions.

3. Cracks spread, and other defects appear on the surface.

Every pavement behaves differently, according to the nature of the underlying soil, the position of the water table, the thickness of the layers, the climate, pavement type and geometry, the characteristics of the construction materials, and traffic, among other factors. It is essential that all of these parameters be taken into consideration in order to adequately diagnose the causes of deterioration.

Understanding the phenomena of pavement deterioration makes it possible to identify the right solutions to counteract it.

A northern environment

Québec can experience temperature variations as large as 60°C to 70°C. The temperature can drop as low as -30°C in winter and reach +30°C in summer. In winter, the ground freezes to a depth of between 1.2 m and 3.0 m. This is much thicker than pavement structures, which average 90 cm in thickness.

The following table compares the Québec environment with that of Ontario, New York State, and France. Two important features emerge from this comparison: the harshness of the climate and the extensiveness of Québec's road network compared with the number of inhabitants.

Comparison across multiple jurisdictions in 2024

	Québec	Ontario	New York	France
Length of the road network (km)	31,000	16,900	21,150	21,246
Number of inhabitants (millions)	9	16	20	68
Average annual precipitation (mm)	1,000	850	800	800
Frost duration (days/year)	147 to 218	100 to 200	10 to 100	0 to 90
Frost-depth (m)	1.2 to 3	1 to 3.2	Less than 1.4	0 to 0.8

Solutions adapted to the climate

Bitumen that is adapted to the climate need to be used to prevent the coating from becoming too brittle in the winter and to allow it to remain rigid enough in summer.

Drainage ditches along roadways and raising the pavement elevation are widely used options to reduce the risk of the water table rising above the road level. In some cases, the installation of drainage devices, such as gravel, synthetic membranes, or a closed drainage system that allows water to drain away from the road structure, becomes necessary.

Another typical requirement is to protect frost-prone soils from the cold. For example, the thickness of sand and gravel layers on northern roads is greater than on roads in warmer regions.

Occasionally, deeper excavations are required to remove the problematic soil and replace it with another, less gel-forming one. In some cases, the soil is stabilized using chemicals such as lime. In some cases, an insulating layer is inserted in the pavement to slow the penetration of frost. Insulating layers are generally made of high-density polystyrene.

The installation of certain devices or the use of special products entails additional costs. In the longer term, however, they can result in substantial savings. These methods are therefore only used if the financial gain attributable to extending the pavement's service life is worth the initial investment.

Ups and downs of flexible pavements

Under the effect of cold, frost penetrates soils gradually from top to bottom (see Figure 2) and damages the structure. Under certain unfavourable conditions, the water contained in unfrozen soils can be drawn into the frost zone. This pumping of water from the water table leads to the formation of ice lenses, resulting in pavement heaving.

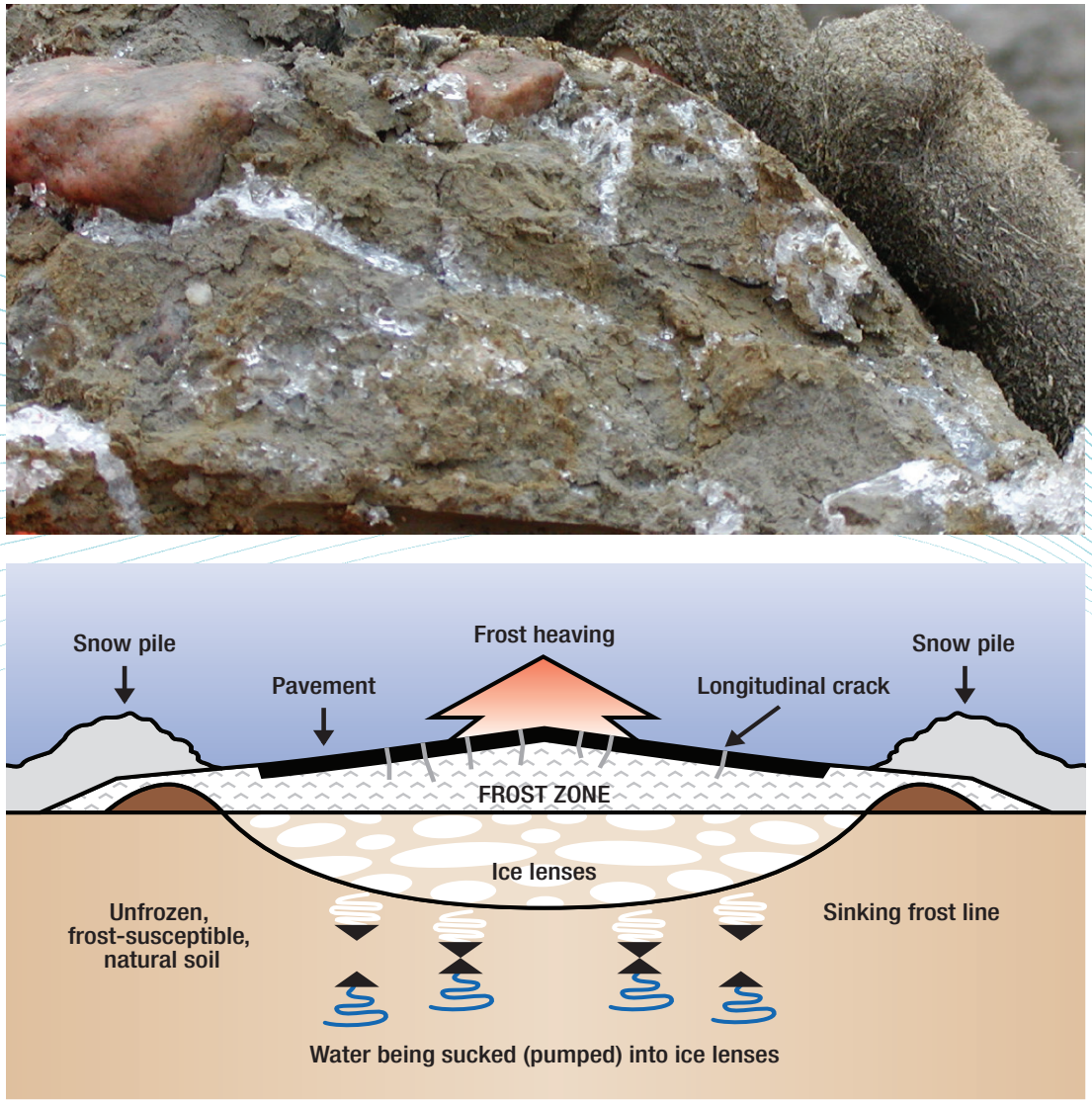


Figure 2: Freeze/thaw effects on pavements

A) Frost heave

Because of their size, these lenses can lift the pavement by up to 20 cm. Lifts are often uneven, which explains the dips and bumps that are most prominent in late winter when frost depths are at their deepest.

This pavement shows a heave of 20 cm.

These lenses also cause the pavement to fold, leading to the appearance of more or less longitudinal frost cracks. Also, like any other material, asphalt hardens, weakens and contracts under the effect of cold. By shrinking over long lengths, the pavement is subjected to tensile stresses that cause it to break, producing transverse cracks.

To make matters worse, the spring thaw is also a top-down process. Water from melting snow on the pavement surface and from melting ice lenses in the ground is found in large quantities in the layer of thawed soil. This accumulation of water significantly weakens the ground. Furthermore, this water is trapped in the ground by the watertight frozen layer below (see Figure 3). This phenomenon contributes to pavement sinking during thaw periods.

Longitudinal cracking, as depicted in Figure 2

B) Dips caused by thawing

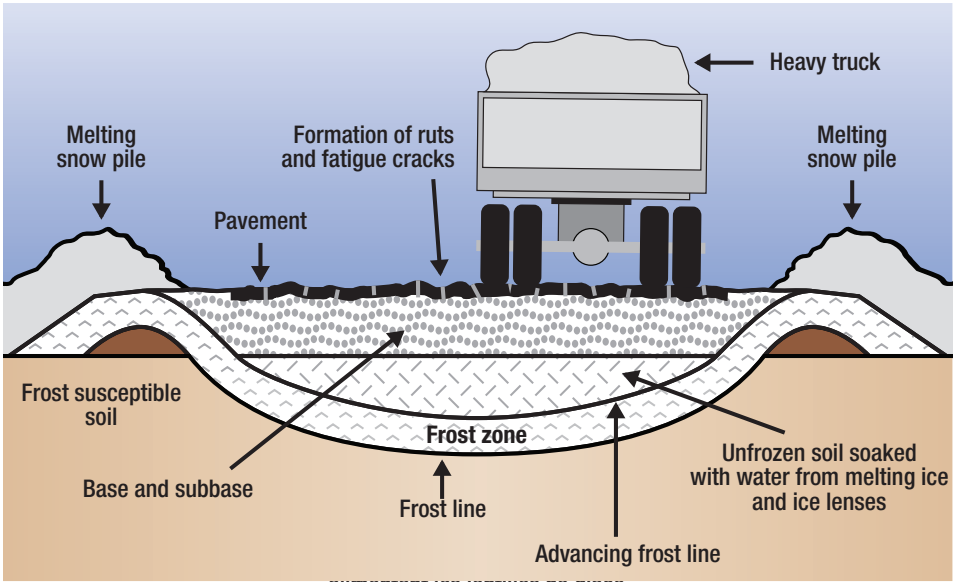


Figure 3: Effect of traffic during the thaw period

The pavement then has only 30% to 70% of its normal summer strength. For this reason, load restrictions are imposed on heavy vehicles to limit damage during thaw periods.

The pavement drains during the summer, and the cycles are repeated every year, causing further deterioration. Damage accelerates over time, as the appearance of small defects creates additional areas of weakness, allowing more water to penetrate, worsen and spread more rapidly from one cycle to the next. So, even for pavements, life up north is not always easy.

REGULATIONS GOVERNING LOADS

The *Vehicle Load and Size Limits Regulation* establishes, among other things, the various load limits according to axle class (axle load) and vehicle classification (total loaded mass). The primary aim of this Regulation is to avoid premature deterioration of road infrastructure caused by vehicles carrying excessive loads.

Regulations governing vehicle loads and sizes have to consider not only economic costs and benefits, but also road safety and environmental constraints. It is impossible to ignore the fact that load limits directly influence the number of vehicles on the road as well as mobility choices.

Economic importance of transport

The globalization of markets is forcing Québec industry to become increasingly competitive. Transport costs represent a significant proportion of the total production cost of a manufactured product. In order for Québec to remain competitive, the Ministère des Transports et de la Mobilité durable needs to provide infrastructure that facilitate the transport of goods at the lowest possible cost. Of all the modes available, road transport is undoubtedly the one preferred by a large number of shippers, largely because of its flexibility, speed and competitive costs. However, shippers and carriers who choose trucking must contend with limits in terms of authorized loads.

It has been demonstrated that high load limits would contribute to faster deterioration of the road network, but would be beneficial to the economy, and that, conversely, low load limits would reduce road network maintenance costs but would be detrimental to several economic sectors. In these circumstances, it is essential to find the right balance between these two positions.

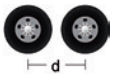
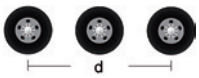
Major trade corridors

Maritimes – Québec – Ontario – Midwest

Québec – New England

Québec – New York

TABLE 1: Axle load limit

CLASS OF AXLES			PERIOD		REDUCTION
			NORMAL	THAW	
B.10	Single axle		10,000 kg	8,000 kg	20%
B.21	Tandem	 d ≥ 1.2 m	18,000 kg	15,500 kg	14%
B.33	Tridem or tridem equivalent	 3.6 m ≤ d ≤ 3.7 m	26,000 kg[1]	22,000 kg[1]	15%
B.45	A self-steering axle in front of a tridem[2]	 2.5 < b ≤ 3.0 m 3.6 m ≤ c ≤ 3.7 m	34,000 kg	29,500 kg	13%

1 The limit is reduced by 1,000 kg in the case of a tridem equivalent.

2 This axle class must be equipped with a suspension system designed to distribute the mass evenly across all axles, within about 1,000 kg, and without any possible adjustment.

TABLE 2: Limits of total loaded mass

CLASS OF VEHICLES OR COMBINATIONS OF VEHICLES	PERIOD		REDUCTION
	NORMAL	THAW	
	25,250 kg	22,750 kg	10%
	41,500 kg	36,500 kg	12%
	49,500 kg	43,000 kg	13%
	57,500 kg	50,500 kg	12%
	62,500 kg	57,500 kg	8%

Method for establishing the axle load

The maximum load allowed for an axle class is the smallest of the following three values:

- Total capacity of all tires (stamped on the side of the tire by the manufacturer)
- Load capacity of the front axle
- Load limit stipulated in the Regulation according to the axle class. This limit varies depending on the period of the year (normal or thaw)

Method for establishing the total loaded mass

The maximum total loaded mass of a road vehicle or combination of road vehicles is the lesser of:

- the total loaded mass computed by adding the approved maximum axle loads. This limit varies depending on the period of the year (normal or thaw)
- the total loaded mass limit of the class of road vehicle or combination of road vehicles, as stipulated in the Regulation

Decreased load limits

Load limits for heavy vehicles were reduced by an average of 2,000 kg for most vehicles with three or more axles. These downward adjustments, which were in line with efforts to harmonize standards, favour the most efficient vehicles in terms of road safety, and protect the road network, were gradually implemented over time. Several types of vehicles were targeted by these major load restrictions, with the result that load limits have never been so low. For example, the maximum total loaded mass for a 10-wheel tipper has decreased from 28,500 kg to 25,250 kg – a reduction of 3,250 kg, or 11.4%.

Data from trucking surveys show that only 9% of vehicles were operating with the maximum permissible load. In the remaining cases, vehicles were either unloaded, partially loaded or subject to volume-limited loads.

Other jurisdictions

As a general rule, standards applied by neighbouring jurisdictions tend to influence each other.

DETERMINATION OF THE THAW PERIOD IN QUÉBEC

In Québec, the freezing period is followed by an initial stage of warming of the air temperature. During this transition period, pavements begin to thaw, from top to bottom, on days when atmospheric temperatures exceed the freezing point, at the same time that long hours of sunlight are observed.

During the spring thaw period, load limits for heavy vehicles are reduced to protect the road network, which has a lower load-bearing capacity. The Vehicle Load and Size Limits Regulation specifies the applicable restrictions. These load reductions are around 8% to 20%, depending on the axle class.

Milestones in the history of the thaw period

The first provisions concerning load restrictions during the thaw period date back to 1955. The regulation governing heavy vehicle traffic on certain roads in the province was then adopted under the Motor Vehicles Act. This Act empowered the Minister of Roads to determine 50% load reductions in thaw or rainy periods.

Then, beginning in 1968, the Ministère undertook to monitor the evolution of the thaw period more methodically, through the use of probes placed in the pavement and commonly known as “frost tubes”.

The start and end dates of the thaw period have been recorded systematically since 1977, as evidenced by the table entitled “Thaw history”.

Determining thaw zones and dates

Since 1991, Québec has been divided into three thaw zones, where the start and end of the load restriction period are slightly staggered over time. This division of Québec’s territory into three zones was established according to the geographic realities, the usual frost depth and the thaw trend in the various regions, the spring climate conditions and the traffic of heavy vehicles along the east-west axis.

Until very recently, the Ministère would use over 90 frost tubes, dispersed throughout Québec, to monitor the freeze/thaw progression and determine the start and end dates of the thaw period. The Ministère's personnel working in the regions were responsible for reading the frost/thaw depths in the frost depth tubes at specified time intervals. This information made it possible to determine the start and end dates of the load restriction period.

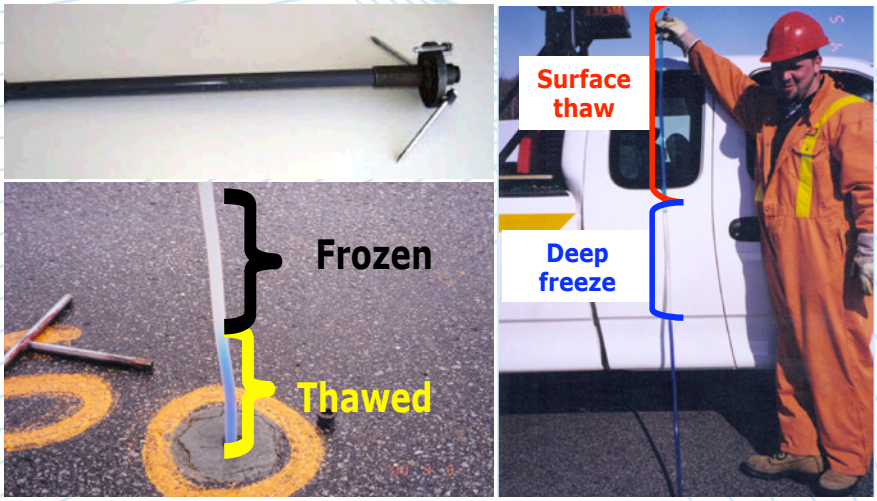


Figure 4: Frost tube – Reading a frost tube

Since winter 2014–2015, the freeze/thaw progression in pavements has been monitored with temperature data collected at the road weather stations, which have technology that allows fully automated monitoring.

The establishment of the actual load restriction period depends on the thaw depths calculated with data from road weather stations and analysis of weather forecasts.

The start of the load restriction period is determined by considering the extent of the thaw observed in a zone on a given date. The extent of the thaw is the proportion of the stations indicating a thaw depth of 30 cm. The start of the load restriction period is established when the extent of the thaw reaches at least 30%.

The end of the load restriction period in a zone is set 5 weeks after the thaw depth in 50% of the stations has reached 90 cm.

In accordance with section 419 of the Highway Safety Code, the Ministère, by order published in the *Gazette officielle du Québec*, determines the dates and zones where the restrictions apply.

Road weather stations to measure the frost and thaw depths

Nearly 54 road weather stations (RWS) are installed on the road network to collect the meteorological data affecting winter driving and pavement behaviour. The stations (Figure 7) are equipped with atmospheric sensors, pavement sensors and a 3-metre-long electronic probe buried in the base of the roadway. The information provided is necessary for various aspects of winter maintenance, frost and thaw monitoring, and pavement design. The sensors and probes installed in the pavements continuously record the following information:

- Sensors: surface characteristics such as moisture, presence of ice, snow, liquid or ice thickness, salinity, temperature.
- Electronic frost tubes (Figures 5 and 6): temperature at various depths to calculate frost/thaw in pavements.

This information is used to:

- Promote safe driving in winter. Information on surface conditions allows maintenance operations on the network to be adapted.
- Enable monitoring of freezing and thawing in pavements, thereby determining periods of load restrictions during thaw periods.
- Measure the influence of climate change and assess the effects of heavy vehicles on pavement performance.

The continuous operation of this equipment is essential to winter and spring management of the road network.

Figure 5: Overview of printed circuits of the electronic frost tube

Figure 6: Electronic frost tube

Figure 7: Road weather station (RWS)

Thawing process in pavements

The load restriction period is divided into two phases:

- The first phase is when the ground actually thaws, from the surface down to the lower layers. During this phase, the load-bearing capacity of the road is considerably reduced. This is because the water produced in the ground during thawing becomes trapped by the underlying layers of soil, which are still frozen.
- This is followed by the phase during which the pavement regains its strength, which continues once the ground has completely thawed. This recovery requires the drainage of the water produced during thawing.

The ambient temperature strongly influences the evolution of the first phase of thawing, which essentially corresponds to the first weeks of the load restriction period. However, temperature has less effect on the duration of the second phase, known as the recovery phase

Comparison with other jurisdictions

Most Canadian jurisdictions impose load restrictions on their road networks during thaw periods. Similarly, 19 states in the northern United States also impose similar restrictions. Most jurisdictions with load restrictions during thaw periods do not impose any load restrictions on their main network, except for vehicles that exceed load limits. Only Québec imposes such restrictions on all public roads.

Québec's reasons for this are as follows:

- Frost depth is highly significant.
- Its road network is aging.
- It is difficult to control loads on the secondary and municipal networks.

Reassessment of load restrictions

Québec conducted a comprehensive review of the load restrictions at the request of the Québec industry (carriers and shippers) and other Canadian jurisdictions. The review found that:

- The costs incurred by the industry due to load restrictions during thaw periods are similar to the additional road maintenance costs that would result from lifting the restrictions.
- The imposition of load restrictions during thaw periods is therefore fully justified, and a partial lifting of the restrictions that would apply only to the main road network is not feasible.
- The Ministère des Transports et de la Mobilité durable is aware of the inconvenience caused by load restrictions during thaw periods. However, it needs to make sure that road surfaces, which are more fragile during thaw periods, are protected as much as possible in order to prevent damage to this public asset.

LOAD RESTRICTIONS DURING THE THAW PERIOD

In winter, weather conditions in Québec are particularly harsh. Depending on the region, the ground freezes to a depth of 1.2 m to 3 m for more than 4 months. This factor, combined with sudden temperature swings and humidity, has a major impact on pavement performance. Freeze/thaw cycles also weaken roadways.

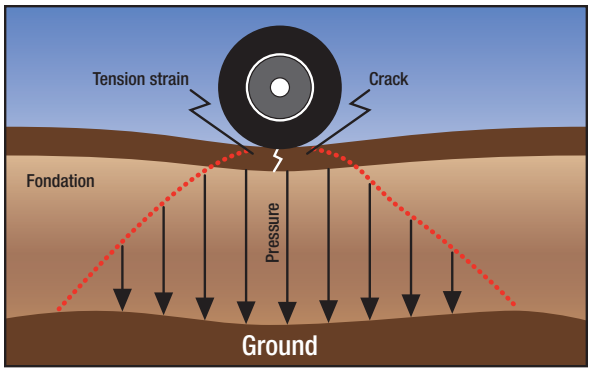


Figure 8: Pavement responses under loads

In spring, the layers of material that make up the road are weakened by water accumulation due to melting ice. Studies conducted by the Ministère on road load-bearing capacity have shown that pavement responses under loads at this time of year are 50% to 70% higher than those recorded in the summer.

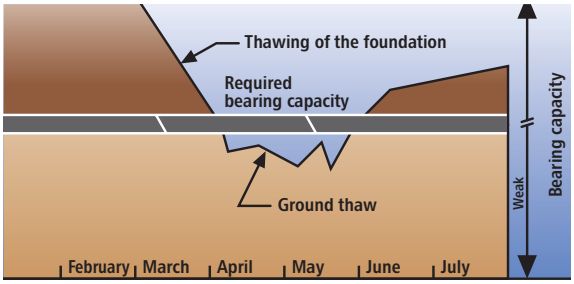


Figure 9: Shifts in load-bearing capacity of pavements

At any time of year, a vehicle that is 25% overloaded will cause nearly 150% more damage. During thawing periods, this phenomenon is amplified, and the same axle load can cause 5 to 8 times more stress than normal.

The effect of heavy vehicles during thaw periods is therefore all the more significant given that the number of commercial vehicles has increased considerably over the years. That is why the Vehicle Load and Size Limits Regulation requires carriers to reduce their loads.

These restrictions are not so much intended to prevent surface damage, such as potholes, but rather to prevent deterioration of the pavement structure itself, which often leads to permanent deformation and therefore a loss of surface quality.

During thaw periods, roads are 30% to 70% more fragile than normal, and a single overloaded truck can cause significant damage.

Therefore, in order to minimize pavement deterioration during this period, the Ministère des Transports et de la Mobilité durable imposes more restrictive regulations on road carriers with regard to vehicle weight.

ROAD INSPECTION

Contrôle routier Québec, an agency of the Société de l'assurance automobile du Québec, is responsible for making sure heavy vehicles comply with load regulations. For the 320 road inspectors spread across Québec, the thaw period is a busy time for weighing operations. The inspectors perform their duties from 31 roadside inspection stations with more than 600 portable weighing devices.

To prevent accidents and effectively protect the road network, inspectors apply a strict compliance policy. In accordance with this approach, an overloaded or unsafe vehicle cannot return to the road until it complies with regulations. When a vehicle is overloaded, the truck driver must distribute the load among the axles or unload the excess weight before returning to the road.

An overloaded truck not only damages the road network, but also impairs road safety. Compliance with vehicle load limits is essential to make sure all road users are safe, and the road network is protected.

As part of their mandate to improve road user safety, protect the road network and ensure fair competition among transport companies, road inspectors enforce several laws and regulations governing the road transport of people and goods, including the following:

- *Highway Safety Code*
- *Act respecting owners, operators and drivers of heavy vehicles*
- *various road transport laws*
- *Fuel Tax Act*
- *Environment Quality Act*
- *Criminal Code*

ROADSIDE INSPECTION STATIONS AND LOCATIONS

Boucherville	20 West
Brossard	10 West
Témiscouata-sur-le-Lac	85 North
Chambord	169 South
Laval	13 South
Laval	25 South
Saint-Sulpice	40 West
Les Cèdres	20 East
Lévis	20 West
Lévis	73 North
L'Islet	20 East
Litchfield	148 East
Lochaber	50 East
Lochaber	148 West
New Richmond	132 East
Pointe-Lebel	138 East

Québec	73 South
Rouyn-Noranda	101 North
Saguenay	175 North
Saguenay	175 South
Saint-Augustin-de-Desmaures	40 East
Saint-Augustin-de-Desmaures	40 West
Saint-Bernard-de-Lacolle	15 North
Saint-Célestin	55 North
Saint-Étienne-des-Grès	55 South
Saint-Mathieu-de-Belœil	20 East
Sherbrooke	112 East
Stoneham-et-Tewkesbury	175 North
Trois-Rivières	40 East
Val-d'Or	117 South
Vaudreuil-Dorion	40 East

In addition to the roadside inspection stations, the road inspectors use some 20 checkpoints, which are secure sites where heavy vehicles are inspected. The checkpoints are located throughout the province.

Some statistics

- In addition to heavy vehicles registered in Québec, road inspectors check approximately **14,000 vehicles** used to transport people and goods registered in another province or a state each year.
- Over the past four years, Contrôle routier Québec has carried out **369,159 roadside inspections**, either on patrol or at checkpoints and rest areas.
- The overall compliance rate for trucks with regard to authorized weight is around **97%**. During the thaw period, this rate can drop to **93%**.
- This drop in the compliance rate during thaw periods can be explained by the additional load restrictions. This situation means that a number of truck drivers who are used to transporting partial or volume-limited loads find themselves with loads close to the permitted limits.
- During the 2024 thaw period, Contrôle routier Québec carried out nearly **22,000 inspections**, which resulted in **1,516 offences** and **60 notices** of non-compliance related to axle overloads or total loaded weight exceeding the limit. Approximately 55% of the offences involved axle weights.

FREQUENTLY ASKED QUESTIONS ABOUT PAVEMENTS

1. What types of bituminous (asphalt) pavements are used on Québec roads?

Bituminous coatings are generally composed of several layers that contain different types of asphalt. There are many combinations of bituminous mixtures, but there are approximately ten that are more commonly used, depending on the purpose of the layer. The "base" normally consists of a more granular mixture that has excellent structural qualities. The mixtures that are used for the surface must provide characteristics that ensure adequate skid resistance, driving comfort, and increased resistance to wear.

2. Where do potholes come from and how do they form?

Potholes are the final stage in a series of phenomena that cause pavement surface deterioration.

The sequence of events is as follows:

- Cracks appear due to various causes, such as heavy traffic, freeze/thaw cycles, construction defects, etc.
- Cracking deteriorates due to stress concentration under the effect of traffic and the appearance of multiple cracks.
- Water and brine infiltrate the structure, thus contributing to the reduction of the foundation's load-bearing capacity and the acceleration of the deterioration process.
- Freeze/thaw cycles accelerate this deterioration.
- Traffic effects: dynamic impacts, the number of vehicles and the severity of the phenomena described above are all factors that determine the speed at which potholes appear.

An infographic, available on the Ministère's website, explains the phenomena leading to the formation of potholes.

3. Can potholes be prevented in our climate?

In general, the formation of potholes is closely linked to the condition of the road surface. The risk of potholes forming depends on the degree of cracking in the pavement, the amount of traffic and the amount of water that can seep under the pavement. The best way to prevent potholes from forming is to carry out maintenance work to keep the road in good condition.

Potholes can therefore be prevented provided that pavements are suited to local weather conditions, are not subjected to traffic levels that exceed their design capacity, and that adequate maintenance can be carried out within the required time frame.

It is important to remember that load restrictions on heavy vehicle during thaw periods are not intended so much to protect the road surface, which is damaged by all vehicles (as evidenced by the fact that a residential street where heavy trucks do not travel can have potholes), but rather to preserve the structure of the road itself.

4. How long does a “cold asphalt” repair last compared to a “hot asphalt” repair?

Cold asphalt repairs are generally carried out as part of an emergency response. These temporary repairs are primarily intended to ensure user safety. The lifespan of these repairs is generally less than one year, and more extensive corrective work is often required during the summer season. This is why the use of hot asphalt is strongly recommended during the winter months.

Regardless of the season, though, it is important to use good repair practices, including drying the crack or hole and applying a bonding agent. By following this procedure, the repair can be expected to last for two to five years. Repair work carried out during the summer generally lasts the longest.

A technical bulletin published by the Direction générale du laboratoire des chaussées (highways laboratory) deals specifically with this topic. It is available [in French] online on the Ministère’s website.

5. How long can a repair to the road surface (top layer of pavement) be estimated to last?

For pavements that are actually subjected to the traffic for which they were designed, as well as high-volume roads (national roads and highways), the lifespan of a bituminous overlay with a thickness of 40 to 50 mm varies from 9 to 14 years. On less heavily used roads or roads with lower speed limits, the expected lifespan of such a pavement is around 15 years, based on the generally accepted standard performance for repairs to the top layer of pavement.

In addition, as traffic flow has a direct impact on pavement durability, the service needs on the Ministère des Transports et de la Mobilité durable network are assessed annually. Traffic data is collected, processed, analyzed, and validated. The database is updated to monitor and predict changes in the condition of the road network.

6. Given our climate, how can we improve the condition of roads and streets in Québec?

It is essential to establish network-wide intervention strategies and set specific objectives in order to effectively improve road quality.

However, optimizing interventions across a network requires prior knowledge of the precise condition of the roadways in order to determine the most appropriate work to be done. Once all this information has been collated in a pavement management system, it can be used to determine the performance of different maintenance scenarios based on the allocated budgets, and to make short-, medium- and long-term projections to achieve the improvement targets.

Improving the quality of interventions also requires the use of materials that are suited to traffic loads and weather conditions. The design stages and the attention to detail during the work are also key factors in ensuring the durability of repair and maintenance work.

7. Why does road quality vary so much within the same area?

Each level of government, whether a municipality or the Ministère des Transports et de la Mobilité durable, is responsible for maintaining its road network. Each level sets its own objectives and manages its budget accordingly. In general, maintenance needs are directly related to the age and level of use of the network, which can vary considerably from one location to another.

However, much of the extensive upper network, which is the responsibility of the Ministère des Transports et de la Mobilité durable, was built in the 1960s and 1970s. Several sections, which are generally more heavily used than the municipal network, are now in need of major repairs. In the current context, where the aging upper network requires significant maintenance, the Ministère's primary objective is to make sure road users are safe. Therefore, work to fill ruts that could cause aquaplaning will be given priority over work that is simply intended to enhance ride comfort.

The Ministère therefore closely monitors the condition of the road network in relation to the funds allocated for its maintenance. This sound management ensures that Québec taxpayers get the most out of their investments.

8. Does the Ministère des Transports et de la Mobilité durable carry out research into component technologies or innovation?

The Ministère is highly active in researching and developing new ways to improve its actions on the road network. For example, since the early 1990s, the Ministère has been monitoring the performance of specific works carried out on sections of road considered representative of its road network. This approach allows it to evaluate the potential use of various techniques and products or to validate their use. Among the studies carried out by the Ministère that have led to improvements in the quality of roadworks, the following are worth mentioning:

- Research on bitumen and asphalt mixes, leading to the establishment of bitumen selection criteria based on Québec weather conditions. This work has resulted in maximized performance of asphalt mixes.

- Reuse of pavement demolition materials. This practice is used in major projects, particularly in the Greater Montréal area. Concrete elements such as slabs, curbs, lamppost bases, etc. are crushed and reused as aggregates. These aggregates are used in the production of the subbase for road reconstruction. Several thousand tons of materials have been reused this way since 1998. This approach is therefore fully in line with the objectives of the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs and the Ministère des Transports et de la Mobilité durable in terms of recycling and reducing the impact of construction work on the site.

- The use of thermal insulation on sections of the network where major frost-related problems have been reported. The use of insulation, which was still experimental a few years ago, is now such a proven, reliable and economical technique for providing definitive solutions in certain specific contexts that it has become standard practice.
- The recycling of bituminous surfaces during road rehabilitation, which began in the early 1990s, is now common practice in both urban and rural areas. As a result, more than 6,000 km of roads on the Ministère's network have been resurfaced using this technique. This work, carried out in a variety of contexts, has clearly demonstrated the performance, utilization rate and cost-effectiveness of this approach.

9. How is it that a northern province like Québec has not yet developed a "high-performance" asphalt recipe?

It is important to note that "indestructible asphalt" does not exist anywhere in the world. However, Québec has made significant progress in the field of asphalt mixes over the last 15 years. The Ministère is participating in major North American research projects that have led to the development of new methods for designing bituminous mixtures that are better suited to our climate.

Work carried out by the Ministère, in collaboration with various research organizations, including universities, has also led to significant improvements in pavement design methods. These better-designed roads offer greater resistance to heavy vehicle traffic and are also less susceptible to the effects of freezing and thawing.

The Ministère has also contributed to the development of pavement inspection methods. This research has led to the design of new equipment for assessing the load-bearing capacity of roads and the automatic measurement of pavement cracking and evenness. These more reliable and productive methods allow more accurate observations and diagnoses to be made, leading to more appropriate intervention choices.

10. What steps does the Ministère follow when building a new road?

The completion of a road project at the Ministère des Transports et de la Mobilité durable is the culmination of several months of study, collaboration, and sustained consultation between the many stakeholders involved. From the submission of the feasibility study to the tender documents, the project manager plans and organizes consultations and prepares requests for studies, surveys, permits, acquisitions, and the removal of obstacles on the right-of-way.

The design of roadways requires consideration of many factors, including:

- The geological, water and geotechnical conditions of the site where the work is to be carried out.
- Expected traffic levels and local weather conditions.
- The choice of materials. Economic analyses of the various options considered will enable an informed choice to be made in order to achieve the quality objectives
- Pavement insulation, calculation of reuse of excavated material, urban drainage (pipe sizing, location of catch basins), relocation of public utilities, where necessary, etc.

The Ministère des Transports et de la Mobilité durable's guide to road project preparation (Guide de preparation des projets routiers), which is primarily intended for technical staff, is the reference tool in this area. This document reviews the activities that are most frequently carried out in the project preparation process.

It can be consulted in French online on the Ministère's website.

FREQUENTLY ASKED QUESTIONS ABOUT VEHICLE LOADS

1. Are load limits higher in Québec than elsewhere?

Load limits in Québec are comparable to those of neighbouring jurisdictions. Québec has made significant efforts in recent years to harmonize its limits with those of its commercial partners.

Since 1991, load limits for vehicles with three or more axles have been reduced by an average of 2,000 kg. These significant reductions are intended to protect road infrastructure and improve safety for all road users.

2. Given the increase in heavy vehicle traffic in recent years, can Québec's road network adequately withstand this additional demand?

Road structures are designed to withstand a certain level of stress. In other words, pavements should be able to withstand a predictable number of vehicles, including trucks, for a given period of time before the road requires total or partial reconstruction. The lifespan of pavements therefore depends on whether this number of vehicles has been reached.

A faster-than-expected increase will accelerate pavement deterioration and reduce its lifespan. Lower than expected traffic will have the opposite effect.

Consequently, traffic that differs from the scenarios initially planned will affect the condition of the network. We know that not all of Québec's roads were designed to handle the traffic we have today, and this affects their performance. For this reason, the Ministère has developed road monitoring and management tools, as well as an intervention strategy to ensure the sustainability of road structures.

3. Why are special permits issued?

A special permit is required when dimensions or loads exceed those permitted under the *Vehicle Load and Size Limits Regulation*. The *Regulation respecting special permits* sets out the conditions that need to be met when a vehicle is non-compliant due to its manufacturing or indivisible load. There are seven classes and two categories of special permits.

4. Would lower load limits reduce damage to the road network?

Lowering load limits during normal and thaw periods would certainly reduce damage to the road network. Road maintenance costs could be significantly reduced. However, the economic cost of such a reduction in load limits to industry would hurt Québec's economy.

Transport costs are directly linked to the authorized load limits. An increase in these costs would make our export products less attractive to foreign markets. The load li-

mits currently authorized are, in most cases, harmonized with those of our main economic partners. Deviations at this level would create additional barriers to trade.

Furthermore, reducing load limits would increase the number of vehicles on the road, which is not necessarily beneficial for the road network or the environment. An increase in the number of heavy vehicles could also have an impact on road safety.

5. During the thaw period, roadways are 30% to 70% more fragile than during normal periods, so why are load reductions only 8% to 20%?

Damage to the road network depends on many factors. One of the most important factors is the load under the wheels of a heavy vehicle. The relationship between load and damage is not linear but exponential. This means that a small overload has a significant impact on the damage that can be caused to the road network. For example, a 20% overload on a single axle is twice as damaging to roadways as an axle that complies with the regulatory limit. Conversely, a small reduction in the permissible limit has a significant effect on the road network. A 20% reduction corresponds to a reduction in damage of approximately 60% compared to an axle loaded in accordance with regulations. The load reductions planned for the thaw period have therefore been adjusted to maximize protection of the road network without harming Québec's economic development.

6. Why is Québec divided into three load restriction zones during the thaw period?

The thaw zones were established based on differences in frost depth, which varies considerably from north to south, the timing of the thaw, the spring weather conditions in different areas of Québec, the geographical characteristics of the province, and the heavy traffic on east-west routes.

Of course, it would be possible to increase the number of zones to better reflect the microclimate of a given area. This would allow the duration of the load restriction period in each zone to be reduced. However, interzone transport by truck would become highly restrictive and mobility would be severely restricted.

7. Why aren't weigh stations along highways open 24 hours a day, year-round?

Inspection stations are operated on a sporadic basis depending on the season, day of the week, time of day, type of transport, and the category of road where the station is located.

Example

During thaw periods, depending on traffic flow, inspection stations are open an average of four to eight hours per day. Some may be open up to 24 hours a day, depending on a schedule that takes neighbouring checkpoints into account. This approach makes sure that major highways are covered as much as possible. Contrôle routier Québec also relies on a mixed strategy, including both fixed and mobile interventions, in particular by creating temporary checkpoints.

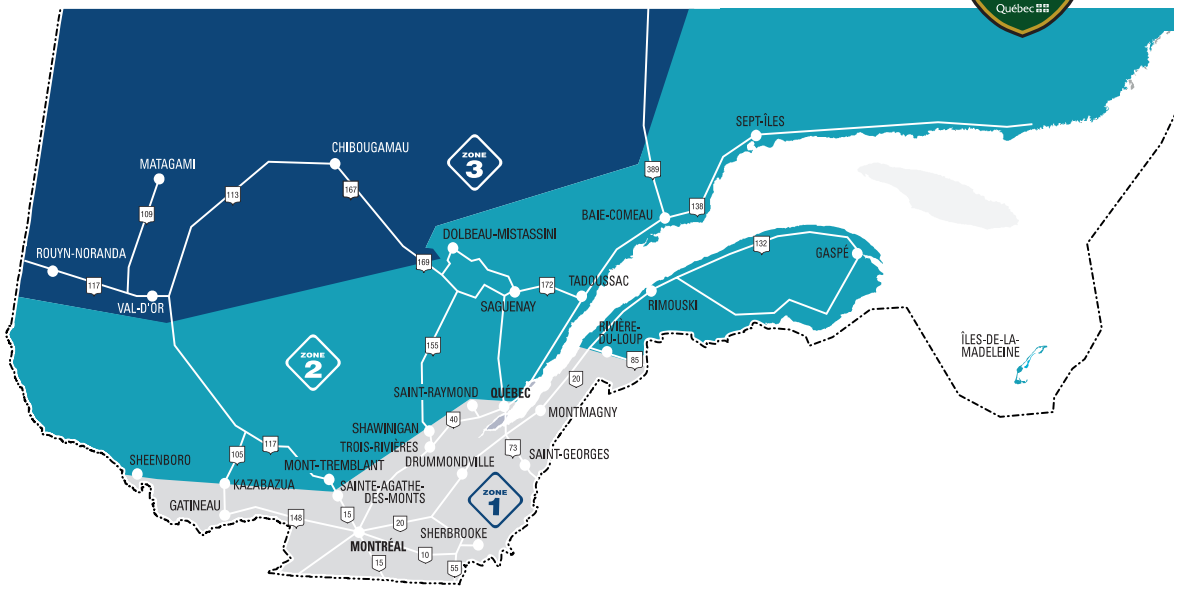
8. Why are other modes of transport not promoted?

The Québec government promotes intermodal transport. That is why it has implemented measures in recent years to support various modes of transport. Additional information is available in French on the "Aide financière [financial assistance]" page of the Ministère's website at www.transports.gouv.qc.ca.

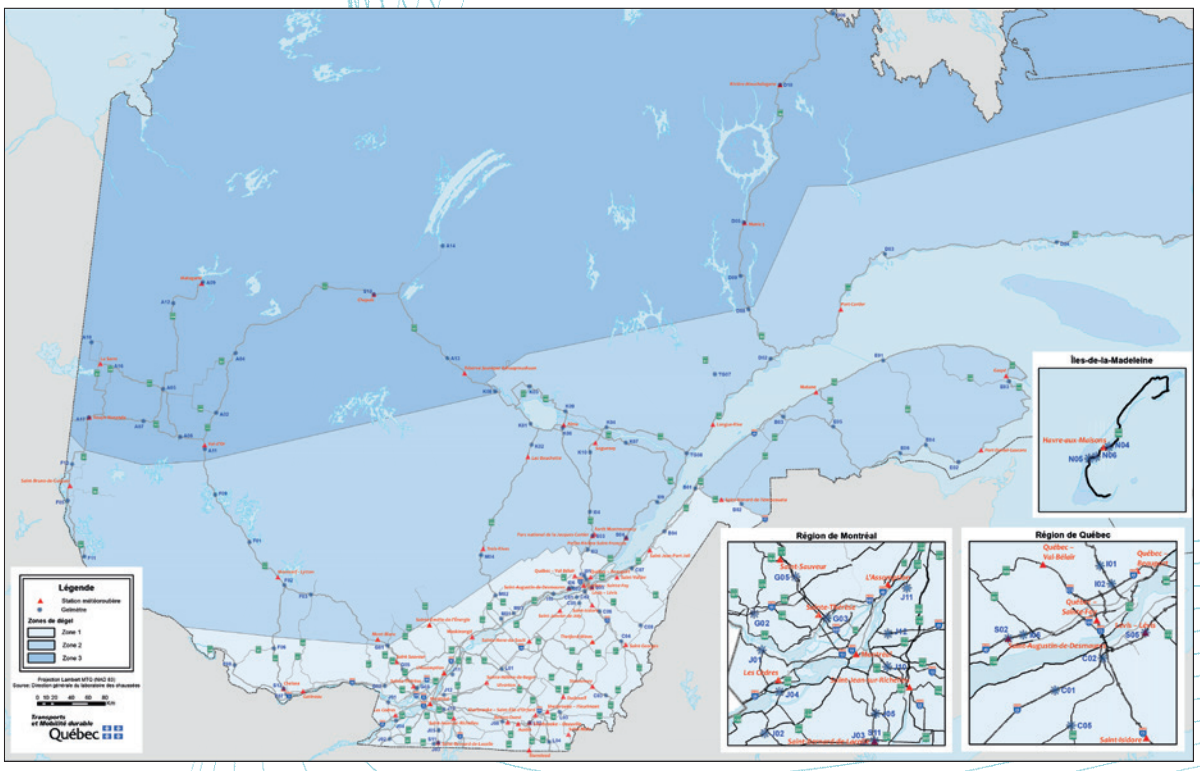
However, it is businesses that primarily use trucking to meet their freight transport needs. They do so for a variety of reasons, including the flexibility, speed, and competitive costs of this mode of transport. Many companies also use just-in-time methods, which involve strict control of the supply chain, a practice that is well suited to trucking.

Furthermore, not all types of goods can be handled interchangeably by the marine or rail sectors. An optimistic estimate puts the number of truck trips in Québec that could be handled by another mode of transport at 6%.

THAW ZONES IN QUÉBEC



LOCATION OF ROAD WEATHER STATIONS



Map of road weather stations and frost tubes (as of November 2024)

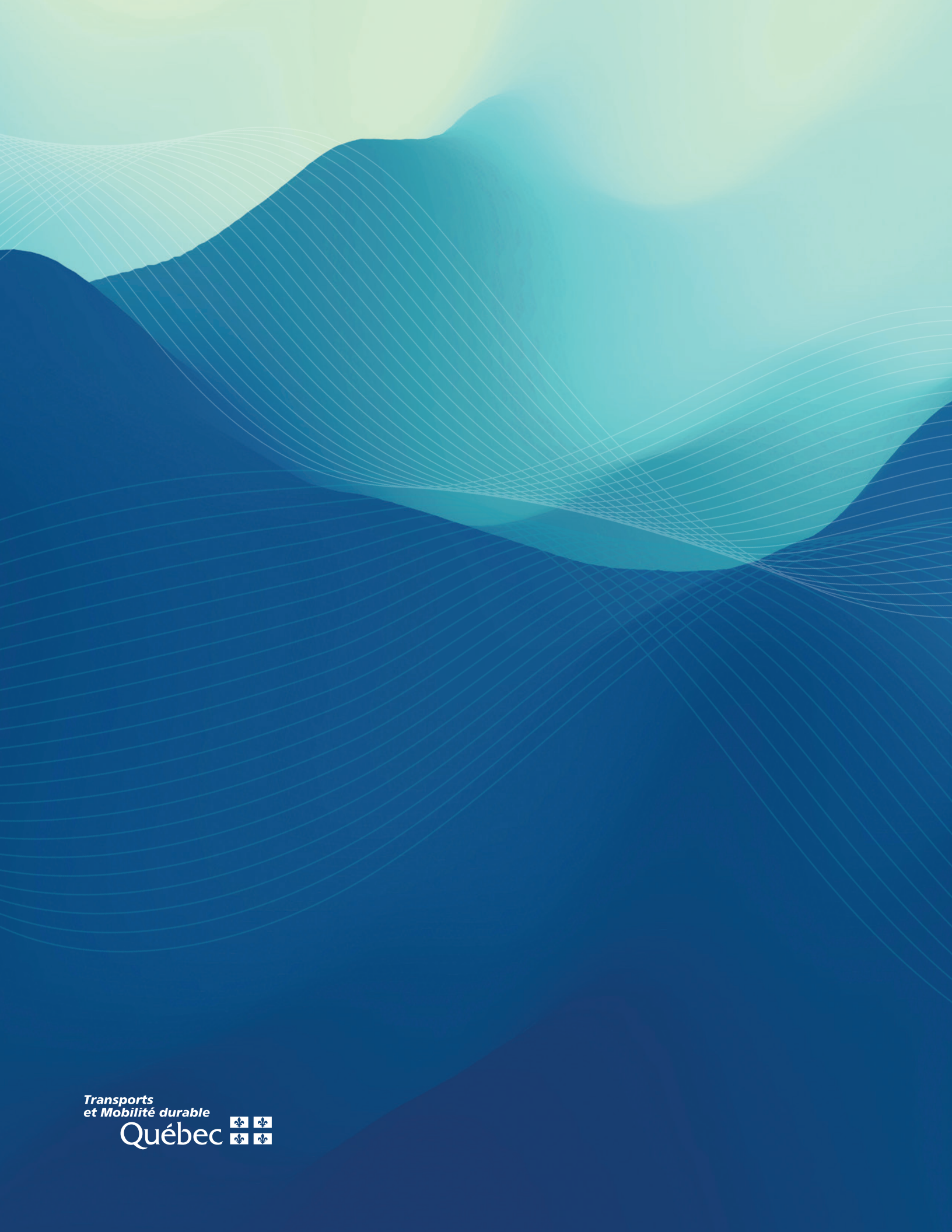
THAW HISTORY 1977–1990

YEAR	ZONE 1			ZONE 2		
	START	END	DURATION (DAYS)	START	END	DURATION (DAYS)
1977	27 March	15 May	49	3 April	15 May	42
1978	27 March	21 May	55	3 April	21 May	48
1979	26 March	21 May	56	2 April	21 May	49
1980	24 March	12 May	49	31 March	19 May	49
1981	25 February	4 May	68	25 February	19 March	64
	---	---	---	30 March	11 May	
1982	22 March	17 May	56	29 March	24 May	56
1983	14 March	2 May	49	21 March	16 May	56
1984	25 February	1 March	54	---	---	---
	26 March	14 May		2 April	21 May	49
1985	18 March	13 May	56	2 April	26 May	54
1986	14 March	9 May	56	1 April	19 May	48
1987	23 March	4 May	42	26 March	11 May	46
1988	20 March	9 May	50	31 March	16 May	46
1989	20 March	13 May	54	31 March	20 May	50
1990	13 March	12 May	60	19 March	24 May	66

THAW HISTORY 1991–2024

YEAR	ZONE 1			ZONE 2			ZONE 3		
	START	END	DURATION (DAYS)	START	END	DURATION (DAYS)	START	END	DURATION (DAYS)
1991	13 March	10 May	58	20 March	17 May	58	28 March	25 May	58
1992	13 March	10 May	58	20 March	17 May	58	28 March	25 May	58
1993	13 March	10 May	58	20 March	17 May	58	28 March	25 May	58
1994	13 March	10 May	58	20 March	17 May	58	28 March	25 May	58
1995	13 March	10 May	58	20 March	17 May	58	22 March	29 May	68
1996	15 March	12 May	58	21 March	19 May	59	24 March	25 May	62
1997	15 March	12 May	58	21 March	19 May	59	24 March	25 May	62
1998	5 March	5 May	61	5 March	12 May	68	24 March	17 May	54
1999	21 March	6 May	46	21 March	15 May	55	24 March	25 May	62
2000	6 March	12 May	67	21 March	19 May	59	24 March	25 May	62
2001	12 March	16 May	65	19 March	16 May	58	26 March	21 May	56
2002	11 March	11 May	61	18 March	18 May	61	25 March	25 May	61
2003	21 March	17 May	57	24 March	24 May	61	31 March	31 May	61
2004	15 March	15 May	61	22 March	22 May	61	29 March	29 May	61
2005	21 March	15 May	55	28 March	21 May	54	4 April	21 May	47
2006	20 March	15 May	56	27 March	15 May	49	27 March	22 May	56
2007	15 March	15 May	61	19 March	19 May	61	26 March	26 May	61
2008	24 March	24 May	61	31 March	24 May	54	31 March	24 May	54
2009	16 March	9 May	54	23 March	16 May	54	30 March	23 May	54
2010	8 March	17 April	41	8 March	24 April	48	15 March	9 May	56
2011	21 March	13 May	54	21 March	20 May	61	28 March	27 May	61
2012	5 March	27 April	54	12 March	11 May	31	19 March	11 May	54
2013	11 March	10 May	61	18 March	17 May	61	25 March	31 May	68
2014	31 March	23 May	54	7 April	30 May	54	7 April	30 May	54
2015	30 March	22 May	54	6 April	29 May	54	6 April	5 June	61
2016	14 March	13 May	61	21 March	27 May	68	28 March	3 June	68
2017	27 February	5 May	68	27 March	19 May	54	27 March	19 May	54
2018	5 March	4 May	61	2 April	18 May	49	23 April	1st June	40
2019	25 March	17 May	53	1er April	24 May	53	15 April	24 May	39
2020	9 March	8 May	60	6 April	15 May	39	6 April	15 May	39
2021	22 March	30 April	39	22 March	14 May	53	29 March	14 May	46
2022	21 March	6 May	46	28 March	20 May	53	28 March	20 May	53
2023	20 March	28 April	39	27 March	19 May	53	17 April	26 May	39
2024	4 March	12 April	39	18 March	10 May	53	18 March	17 May	60

THE ROAD SIGN


Transports
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