

INFRASTRUCTURE FOR THE DISPOSAL OF SNOW IN MONTREAL

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SUMMARY

The City of Montreal has a population of 1,626,000 inhabitants. Public roads total some 4,100 km and 6,500 km of sidewalks. During the winter, Montreal receives an average of 225 cm of snow and temperatures regularly average around -15 °C.

In keeping public roads safe, the City of Montreal has established a snow removal plan divided in 4 phases: the spreading of abrasives, the clearing of streets and sidewalks, the loading and transportation of the snow, and finally, its elimination.

This last phase (elimination) is crucial in Montreal; it must eliminate an average of 13,5 million cubic meters of snow per winter in compliance with environmental standards and the snow storage capacities of the different sites. This has been a real challenge for the City of Montreal over the last fifteen years. Since the year 2000, the City of Montreal has 30 disposal sites.

Highway development and the assurance of having a larger volume of snow than a winter average urges an update of the strategy for snow removal in the long run.

KEYWORDS

SNOW ELIMINATION / SURFACE SITES / SEWER CHUTES

1. MONTREAL IN FIGURES

The City of Montreal has a population of 1,626,000 inhabitants and is composed of 19 boroughs. It is the largest city in Quebec and the second in Canada. As illustrated in Figure 1, Montreal is also the largest of 12 cities that occupy the territory on the Island of Montreal

In terms of public roads, there are some 4,100 km of roads and 6,500 km of sidewalks.

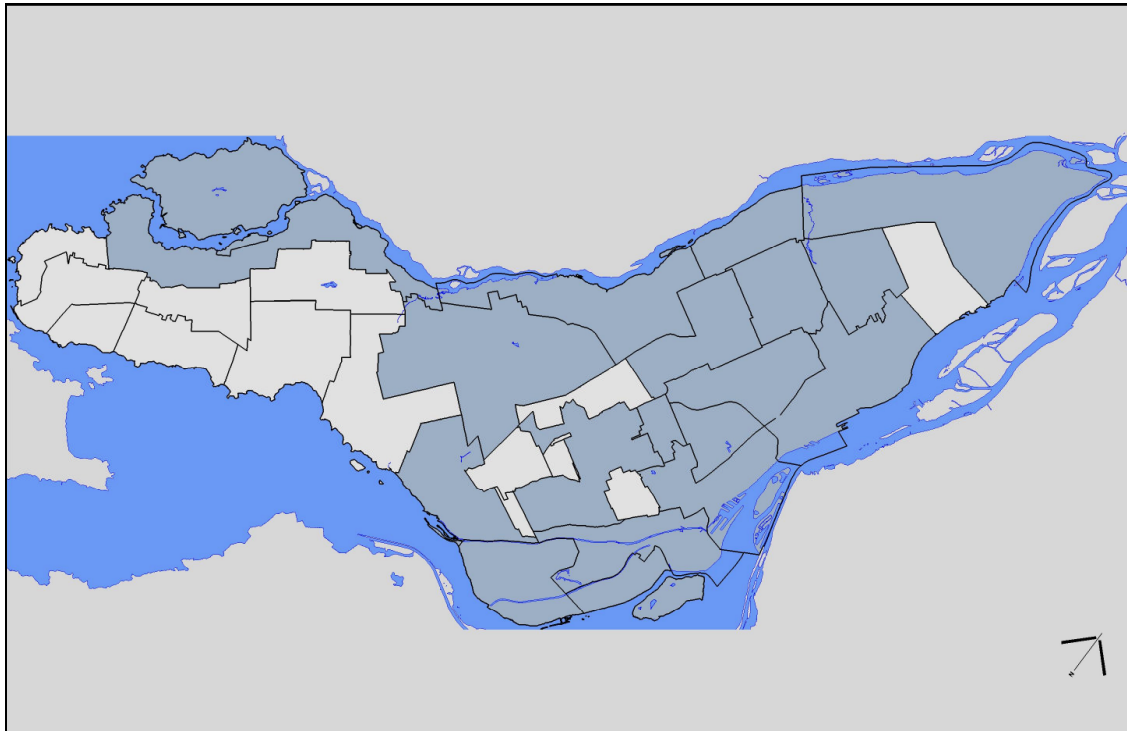


Figure 1 – Territory occupation (dark) by the City of Montreal on the Island

Regarding the winter climate, the City of Montreal receives an average of 225 cm of snow per winter, and the temperature regularly drops below -15°C . In fact, the average temperature for January is -10°C . The first snows fall in early November and the latest in early April.

Snow removal operations consist of four elements:

- The spreading of abrasives at the start of a precipitation;
- The clearing of roadways and sidewalks when 2,5 cm of snow is reached;
- The loading and transportation of the snow (if needed);
- The elimination of the snow.

For an average winter, there are:

- 65 abrasive spreading operations;
- 15 snow plowing (clearing) operations;
- 5 removal (loading) operations;
- The use of 140,000 tons of salt;
- An average of 8 precipitations (snowfalls) of 10 cm and more;
- The elimination of 13,500,000 cubic meters of snow on some 30 sites.

The annual budget for snow removal is \$ 130,000,000.

Finally, when it snows in Montreal, the average temperature is about -5°C , but after heavy snowfalls, the average temperature falls easily below -10°C . Thus, one can not rely on the natural melting of snow in the next few days and should therefore remove the snow in order to maintain clear traffic lanes and parking spaces. That is why large amounts of snow are found on all disposal sites.

2. HISTORY OF THE SNOW REMOVAL

Over the past 40 years, the City of Montreal has used 5 methods of snow disposal.

2.1. Sewer chutes

Using these chutes eliminate about 30 % of the volume of snow annually. Basically, the chutes are large rectangular hatches that allow direct access to the combined sewer system of the City of Montreal, mainly collectors to big interceptors.



Figure 2 – A sewer chute

2.2. Surface sites

Surface sites are the traditional method employed by any municipal authority of disposing snow. The City of Montreal has 13 of these sites which receive about 50 % of the annual volume of snow.

Residential, commercial and industrial developments have forced the City of Montreal to close several of these sites over the years.

In the spring, the drainage is controlled by ditches located at the periphery of the sites, and water is captured by the sewer system, through settling basins.

The capacity of this type of site has been greatly improved since the 1980s by the use of high-performance snow blowers that appeared on the market. These machines adequately replace the traditional mechanical bulldozers by removing more snow on lesser surfaces.



Figure 3 – Removal of snow on a surface site

2.3. Snow disposal in quarries

In the early 1980s, the City of Montreal acquired an old quarry and turned it into a snow disposal site. The heights of the walls (about 70 meters) were well suited for economic exploitation, which is to dump snow at the bottom of the quarry from the top of the cliff. The City of Montreal uses a single quarry (St-Michel) that receives another 20 % of the annual volume of snow.

In the spring, melted snow is pumped out of the quarry to the sewer system.

The bottom of the St-Michel quarry can serve as an emergency disposal site because the snow can be piled with heavy equipment.

The estimated total capacity of the quarry is 5 million cubic meters of snow.

In loading and transport operations, more than 250 trucks enter the site every hour, averaging a truck every 15 seconds.



Figure 4 – Snow disposal in the St-Michel quarry

2.4. Dumping snow in the St-Lawrence River

Until the late 1990s, the City of Montreal had used some docks of the Montreal Port Authority to dump approximately 30 % of the snow in the St. Lawrence River. This practice is now outlawed by provincial regulations. It was by far the most economical and reliable way to dispose of snow. However, it was also the most criticized by environmentalists.

2.5. Snow melters, stationary or mobile

The City of Montreal has operated 7 snow melters heated with oil burners. During the 1970s, the prohibitive cost of this method resulted in the gradual closure of these facilities. One melter survived until 1990 but it removed less than 1 % of the annual snowfalls.



Figure 6 – A snow melter

Of these 5 methods listed above, the City of Montreal now uses only sewer chutes, surface sites and dumping at the St-Michel quarry.

3. SANITATION PROGRAM FOR DISPOSAL SITES

3.1. Provincial regulations and bylaws

In the early 1990s, the provincial government established its policy on the disposal of snow under the bylaw of environmental quality, a regulation on the disposal of snow that was enacted in 1995. Basically, this regulation stipulates that any disposal site must be authorized by the Ministry of Sustainable Development, Environment and Parks (MDDEP) via a certificate of authorization. In order to deliver this certificate of approval, the Department requires specific criteria relating to the environment. Anyone who operates a disposal site without this certificate is liable to severe penalties provided by the bylaw.

Basically through its bylaw, the MDDEP ensures that:

- the melted snow is drained properly and undertakes treatment on the site through a settling pond before it can be discharged to the sewer or a watercourse;
- the melted snow must not penetrate the soil, thus contaminating the subsoil and groundwater, which in some cases, may be the source of the population's water supply;
- the activities at the sites must not cause nuisance to people and must respect zoning bylaws.

The MDDEP also requires an annual environmental monitoring to ensure that facilities perform according to standards defined in the bylaw. For example, a sample of melted snow collected by a piezometer may reveal a fracture in the clay layer for waterproofing sites. The MDDEP would then require that the problem be corrected and would temporarily withdraw the certificate of authorization until the remedial work would be done to its satisfaction.

3.2. Development of the sanitation program

In order to comply with the regulations of the provincial government, the City of Montreal decided in 1996 to produce its own rehabilitation program. Knowing that the practice of dumping snow in the St-Lawrence River was soon to be abolished, hence prohibited, it was crucial to identify new sites or expanded existing locations, to receive the snow that was initially headed for the St-Lawrence River. This program was designed to assess the future disposal of snow, targeting new developments, outlining the financial requirements for these facilities and establishing a working schedule.

The sanitation program was accepted by the Quebec Government in 1998. Therefore, the City of Montreal began to work, having reserved a twenty million dollars budget spread over 5 years. Work to develop sites to replace the dumping in the St-Lawrence River had already begun. These monies were used to complete the work.

Thus was built a new wharf at the St-Michel quarry and 3 new surface sites. At the same time, the City of Montreal upgraded an existing surface site and negotiated a long term agreement with a private own surface site that could accommodate 1 million cubic meters of snow per year.

All these initiatives have helped the City of Montreal in gradually reducing the St-Lawrence River dumping and finally, to completely stop this practice by the end of the 1998-1999 winter.

4. CURRENT INFRASTRUCTURE

Today, the City of Montreal counts on 30 infrastructures to eliminate the average of 13,5 million cubic meters of snow picked up during the winter:

- 16 sewer chutes;
- 13 surfaces sites (1 private);
- 1 quarry.

In an average winter, the 13,5 million cubic meters of snow will be dispatched as follows:

- 4 million in the sewer chutes;
- 2,5 million to the St-Michel quarry;
- 7 million on surface sites.

Even if the City of Montreal has all the permissions of MDDEP, the work does not stop there. The snow disposal is also "governed" by the capacity of the sites, which requires an elimination strategy.

Indeed, the capacity of these modes are different. In developing the strategy for elimination, which is to « steer » the 115 territories to one or the other sites, the City of Montreal must think ahead of all emergencies that may occur, such as the extraordinary precipitations of the 2007-2008 winter.

4.1. Characteristics of sewer chutes

They occupy little space, thus generating minimal impacts to the population and are the least expensive elimination method. Their use is limited by a local hourly capacity that is the capacity of the drain at the bottom of the chute itself, or heat capacity of melting snow flowing in the entire network of interceptors.

The latter is monitored by the plant wastewater treatment in accordance with established criteria, based on the flow of wastewater throughout the network of collectors and the water arriving at the water treatment plant.

The disadvantage associated with the use of sewer chutes is that when there's a loss of heat capacity, problems quickly arise: mainly, the chutes jam. Alternative sites must be available as soon as possible, which is sometimes difficult to manage.

4.2. Characteristics of surface sites and quarry

They occupy large areas, often sought after for other vocations, are unsightly and, in the case of surface sites, are much more expensive than the sewer chutes and the quarry. However, they are subject to seasonal capacity instead of hourly capacity, which allows managers to foresee or anticipate the problems of the elimination strategy. They also offer more flexibility in finding alternative solutions.

The well prepared strategy before winter takes on account all the snow volumes generated by the territories and the capacity of the sites, whether hourly or annually. This strategy can eliminate snow from a stronger winter than the average of 225 cm.

When snowfalls hit 30 cm rather than 20 cm, sewer chutes barely absorb the high rate of loaded snow and the trucks must be rerouted to surface sites. These tremendous volumes of snow fills them prematurely and if the winter is hard, full capacity is reached before the winter is out, and that is exactly what happened during the winters of 2007-2008 and 2008-2009.

5. DEVELOPMENT OF NEW INFRASTRUCTURE

Two realities compel the City of Montreal to develop new infrastructure for the disposal of snow.

First, the development of motorways in the downtown area and its periphery will cause the imminent loss of a few sites, mainly sewer chutes.

Secondly and as indicated in the previous section, the City of Montreal wants to ensure that it can easily remove the snow not only for 50 % of the winters (average winter), but for 75 % of the winters, which corresponds to 17,5 million cubic meters of snow instead of the actual 13,5 million cubic meters of snow.

To do this, the City of Montreal has a \$ 30 million program to develop infrastructure which should span the next 5 to 10 years. This program will provide the expansion of existing surface sites, the construction of new ones and new sewer chutes. It will also expand the capacity of the St-Michel quarry through the laying out of another continuous dock for snow disposal at the bottom of the quarry.

6. CONCLUSION

About 15 years ago, snow disposal was considered as a secondary activity, which took place at the same time as snow removal, and for which, solutions were easy to find in case of problems.

Since then, this activity has had to adapt to new developments of all kinds (highways, commercial, residential, industrial), to environmental consciousness, and to “unusual” climatic events.

All these considerations showed us, the City of Montreal, that snow disposal is not anymore an easy step, but rather a strategic activity. Should this activity be left to itself without any investment? It could easily become a bottleneck and slow down the rhythm of all the snow removal operations.