

Winter Bike Lane Maintenance:

A Review of National and International Best Practices (Updated 2/14)

SUMMARY

This white paper provides collected best practices on winter bikeway maintenance as seen in US cities and around the world. The paper covers snow removal from bikeways, different types of de-icing surface applications and their advantages/disadvantages, and best practices for winter maintenance prioritization and scheduling. The paper also includes a brief discussion on innovative winter maintenance techniques either in use or in development.

Introduction

As bike infrastructure continues to grow in the US, so does the need to maintain these facilities year-round. The regular maintenance of bike infrastructure is especially important in towns and cities with established bicycling networks and significant bicycling populations – if jurisdictions provide bicycle facilities, they can expect that people will use them year round¹.

The winter maintenance of bikeways should be a planned, regular activity in cities and towns that receive significant amounts of snowfall. Bicycles have different winter needs than motor vehicles—for example, less



Bicyclists on Kinzie Street protected cycle track in Chicago, Illinois, after snow clearing.

weight and tire surface area means they are more sensitive to snow and ice—and winter roadway maintenance programs should have specialized practices to respond to these needs. However, many cities fail to adequately maintain their bicycling networks in the winter months. This is typically due to inexperience with winter bikeway maintenance, constrained roadway maintenance budgets, and/or inadequate equipment.

This white paper provides collected best practices on winter bikeway maintenance as seen in North American cities and around the world. The paper covers snow removal from bikeways, different types of de-icing surface applications and their advantages/disadvantages, and best practices for winter maintenance prioritization and scheduling. The paper also includes a brief discussion on innovative winter maintenance techniques either in use or in development.

Snow Removal Best Practices

A heavy snowfall will typically require the initial removal of snow from the bikeway to restore the functionality of the facility. A proactive and reactive de-icing program (discussed in the following section) in conjunction with scheduled snow removal is necessary to help maintain good riding conditions along bikeways in the winter. There are many considerations that factor into how to best remove snow from bikeways in the winter.

1. Gin Kilgore, Alta Planning + Design, Co-founder of Chicago Bike Winter

These factors are the bikeway type, the storage of snow on or off the roadway and the presence and type of vertical protection or separation along a bikeway.

Snow Storage and Roadway Design

One of the best ways to facilitate the removal of snow from bikeways is thoughtful roadway design. While in some cases, snow is removed from the roadway and relocated to a storage site (such as a nearby commercial parking lot), most roadway maintenance programs plow snow off the main portion of the road to the shoulder if one exists, as close to the roadway edge as possible or along a sidewalk buffer if one exists. Unfortunately, with roadways that include typical, unprotected bike lanes at the edge of the roadway, the bike lane often becomes the area for snow storage on the roadway. This practice leaves bicyclists either trying to share the vehicular lane or riding to the edge of the roadway while trying to avoid piled-up snow and stay clear of the vehicular path – both are unsafe and uncomfortable conditions for bicyclists on roadways with designated bike lanes. There are several roadway planning and design considerations that can be taken to avoid this situation.

Plan Roadways with sufficient right-of-way

On new roadways or in roadway re-engineering projects that include bike lanes (or may include them in the future), provide enough right-of-way for preferably a six foot bike lane and a six foot storage space on the side of the road or in the buffer space between the road and the sidewalk (cities that typically receive heavier snowfall such as Montreal prefer an eight foot minimum storage space). This will allow typical truck-mounted snow

plows to plow snow into the designated storage space rather than the bike lane. The six foot width of the bike lane will also allow for some narrowing of the bike lane due to snow while still maintaining its functionality.

Provide a Wide Bike Lane Buffer

Where it is possible to provide one, such as in some “road diet” projects, a wide protected or unprotected bike lane buffer can provide ample storage space for snow. A minimum five-foot-wide buffer is preferable to accommodate moderate snowfall with minimum encroachment upon the bike lane. This design will require the use of a smaller bike lane snow plow to clear this portion of the roadway.



Above: Protected cycletrack in Salt Lake City, UT after small truck plow snow removal. Photo Credit: Travis Jensen

Below: Vertical delineators help inform snow plow drivers of obstacles such as cycletracks, raised medians and bulb-outs in Salt Lake City, UT



Small snow removal vehicle clearing a buffered bike lane in Vienna, Austria. Photo Credit: http://www.ibikeoulu.com/presentations/presentation_oulu_szeiler_130213.pdf



Salt Lake City, UT has designed their protected cycletracks specifically to accommodate snowplows. Protective, flexible bollards are located at a far enough distance from the curb to allow a small truck mounted snowplow to clear the bikeway. Also, cycletracks, medians and bulb-outs in Salt Lake City are designed with tapered front ends and vertical delineators at obstacles to help prevent snowplow blade collisions along these facilities.

Restrict On-street Parking During Snow Events

Where a bike lane is located between on-street parking and the vehicular lane, parking along the roadway can be restricted during snow events to allow this space to become snow storage space. While this isn't an option for all roadways, it could be utilized along priority bicycle routes in the winter.

Provide Off-Street or Parallel Facilities

Where off-street facilities or bicycle boulevards are provided parallel to major routes, the clearing of bike-ways on the main route may be unnecessary so long as these alternate snow routes are clearly marked, well-maintained, and bikeway network connectivity isn't affected.

Provide Enough Width for Small Truck Snow Plows

There are small, specialized snow removal vehicles that are used to remove snow where typical snow removal vehicles are too wide to pass. Many large cities with harsh winter climates such as Chicago have a fleet of these specialized vehicles and ATV-mounted snow plows primarily for the purpose of clearing sidewalks. While most cycle tracks in Chicago can be cleared with typical pickup truck-mounted snow plows, ATV-mounted snow plows and bombardier snow plows are used along the few protected cycle tracks (such as Kinzie Street) that are too narrow for pickup trucks².

In many towns and cities, sidewalk snow removal is contracted out, meaning that the city does not own these specialized vehicles. Utilizing existing maintenance vehicles such as pickup trucks with mounted snow blades can prove to be much more cost-effective and time-efficient than purchasing or using smaller vehicles which operate at slower speeds and have smaller plow blades. Access

2. Sources: Interview with Mike Amsden, Chicago DOT Bikeways Planner and <http://www.suntimes.com/photos/galleries/index.html?story=18655473>

Recessed thermoplastic bike lane marker in Minneapolis, MN. Photo Credit: <http://bikewalkmove.org/tag/minneapolis-bike-infrastructure>



for snow removal vehicles should also be a consideration when designing shared-use paths and greenways.

Recessed Thermoplastic Pavement Markings

Milling the area of pavement three millimeters deep where thermoplastic pavement markings are applied has shown to be effective in reducing damage as a result of snowplows in a 2010 study³. Minneapolis mills the area of pavement where thermoplastic bike lane indicators are placed to help reduce damage as a result of snowplows. While this method results in more expensive installation costs, if the bike lane is located on a street that receives heavy plowing, it may save in long-term maintenance costs (and help preserve safety conditions along the roadway).

Snow Removal Vehicle Type

Along protected, on-street bikeways one major design consideration that influences snow removal is the design and provision of vertical separation. Many cities such as Chicago, Salt Lake City, and New York City are installing protected cycle tracks that include a parking lane, striped buffers and physical barriers between the cycle track and the motor vehicle travel lanes. In Chicago, as in most US cities with protected cycle tracks, flexible-post bollards are installed along the cycle track buffer. These bollards are bolted into the pavement and left up year-round meaning that conventional large truck-mounted snow plows cannot fit down these paths.

Facilities such as protected cycle tracks, shared use paths, and in some cases bike lanes will require smaller snow plow vehicles. Common vehicle types are listed on the following page:

3. http://www.easts.info/publications/journal_proceedings/journal2010/100292.pdf

Truck Mounted Plow Blade

Large trucks are the typical roadway clearing vehicle in most cities with harsh winter climates. These vehicles are also typically used for applying de-icing materials to the roadway. These vehicles can be used to clear and de-ice most roadways with conventional bike lanes.

Pickup Truck-Mounted Plow Blade

Pickup truck-mounted snow plows are typical in many cities with snow removal programs. These are commonly utilized on smaller roadways and in parking lots that are difficult for larger trucks to access. Pickup trucks can be equipped with de-icing equipment as well. Pickup trucks can be utilized on many protected cycle tracks and multi-use paths and it is important to consider pickup truck snow plow access in the design of these facilities.

Small Snow Removal Vehicles

Small snow removal vehicles are available from a number of different manufactures. Many small utility vehicles such as tractors, ATVs, bombardiers, and “skid steers” can be equipped with snow removal devices. Typically small vehicles are either equipped with snow plows, snow brushes (effective for removing light snow) or snow blowers (effective for relocating heavy snow). Many small snow removal vehicles can also be equipped with de-icing applicators as well. Small snow removal vehicles can be utilized in areas too constrained for a pickup truck-mounted snow plow such as narrow, protected cycle tracks.

De-icing Surface Applications Best Practices

There are two primary strategies for roadway de-icing that are used by winter maintenance programs. A reactive approach applies de-icing material to the roadway surface after the storm event. The snow or ice is plowed off the surface and the material is applied to the roadway to break the bond between the ice and the roadway.

A proactive or anti-icing approach applies the de-icing material to the roadway approximately two hours before the snow event. This is the most effective de-icing strategy. Following the snow, the roadway is cleared and additional de-icing material is added as necessary. The advantages of a proactive approach are that less de-icing material and plowing is needed. North Dakota



Example of a bombardier mounted with a snow plow. Vehicles like this and ATVs are used in Chicago along cycletracks that are too narrow for larger snow plow vehicles such as pickup trucks. Image credit: <http://www.publiquip.com>

DOT reports that in the department’s experience, one-third of the de-icing material is needed with proactive strategies compared to reactive ones⁴. More information on de-icing can be found through FHWA: <http://www.fhwa.dot.gov/reports/moepap/eapcov.htm>

The removal of roadway grit resulting from winter roadway de-icing and traction improvement applications is an especially important consideration for bike lanes. Salt and sand tend to accumulate in bike lanes due to motor vehicle traffic, water and wind. Accumulation of this debris can cause discomfort and pose a safety threat to bicyclists along the roadway if not addressed. It is recommended that cities devise a maintenance plan to remove this debris from the roadway, prioritizing primary bicycling routes, once the threat of winter precipitation has passed. In in Järvenpää, Sweden for example, sand and road grit is cleared from all bikeways every year before the 1st of May.

Winter maintenance programs should consider all the advantages and disadvantages of salting and sanding bicycle facilities before determining salting procedures. For example, the Minneapolis Parks and Recreation board typically does not salt and sand entire trails due to cost, ineffectiveness at low temperatures, and environmental consequences, but will apply spot applications after freeze and thaw periods where slick spots occur⁵.

The following section provides an overview of common types of de-icing materials used on roadways and bike-ways and their advantages and disadvantages.

4. <http://www.dot.nd.gov/divisions/maintenance/docs/anti-icingfacts.pdf>

5 Phone interview with Simon Blenski - Bicycle Planner with Minneapolis Public Works Department. January 2014

Salt

Rock salt is a readily available and commonly used de-icing material. After salt is applied to the roadway, it needs to be crushed by tires to dissolve most effectively⁶. The dissolution of the salt creates a brine that prevents ice from bonding to the roadway. The disadvantages of roadway salt are that it is a highly corrosive material and salt-infused stormwater runoff can cause environmental damage. Also, salt loses its effectiveness at temperatures lower than 15 degrees Fahrenheit. At these temperatures, other chemicals such as calcium chloride or magnesium chloride may be used, but these types of mixtures lose most of their effectiveness at temperatures below zero degrees Fahrenheit⁷. Bicycles with exposed gears are especially susceptible to corrosion caused by roadway salt. Also, because of their narrow tires and reduced weight, bicycles may not crush salt as effectively as motor vehicles (however, no studies have been conducted that examine this).

Pre-wetted Salt

Pre-wetted salt is roadway salt that is sprayed down with a brine solution either upon application or in storage prior to being loaded in trucks. Pre-wetting facilitates the dissolution of the salt, allowing for quicker reaction times than dry salt, less material than dry salt and improved application accuracy (dry salt tends to bounce off the travel path).⁸

De-icing Alternatives

Some roadway maintenance departments combine a beet juice solution with roadway salt or salt brine. Beet juice is an inexpensive additive to a de-icing solution that improves the adherence of salt and sand to the roadway and also lowers the freezing temperature of the ice. The advantages of beet juice are that it is inexpensive, it adheres well to the roadway, and it is much more environmentally friendly than using plain road salt⁹. A combination of beet juice and roadway salt or brine can reduce the number of de-icing applications required and save costs.

6. http://www.semco.org/uploadedFiles/Programs_and_Projects/Water/Stormwater/Municipal_Training/Streets_and_Parking_Lots/Road%20Salt%20Application.pdf

7 <http://www.cargill.com/wcm/groups/internal/documents/image/na3036958.pdf>

8. <http://www.ctre.iastate.edu/pubs/semisesq/session1/donahey/index.htm>

9. <http://www.dvice.com/2012-12-29/beet-juice-answer-safer-roads-icy-weather>

Some cities are also utilizing cheese brine, a by product of cheese production, as an additive to rock salt applications. Many cities have reported success with this method in recent years. Like beet juice, cheese brine helps rock salt adhere to the roadway, has a lower freezing temperature than regular brine, and is more environmentally friendly. It provides cost savings for both cheese manufacturers, in terms of waste removal costs, and cities, with reduced expenditures on rock salt¹⁰.

Sand and Gravel

Sand and gravel are abrasives and are used primarily for providing roadway traction – these materials have little ability to melt ice. The application of sand is usually done in conjunction with salt or other deicing treatments. While sand is good for providing traction, too much sand can pose a hazard for bicyclists. Sand can get trapped in the bicycle's drivetrain and wet sand can get on a bicyclist's clothes. If sand is applied to a roadway with a bikeway it should be cleared as soon as possible when the threat of winter precipitation has subsided. The use of sand can also have negative environmental impacts, especially when mixed with salt¹¹.

Larger particulate sand or gravel applied to the roadway can be hazardous to skinny bicycle tires due to the larger size of the aggregate. Gravel is not recommended along roadways with on-street bikeways

Innovative and Experimental Snow Removal

Several European cities with harsh winter climates and high bicycling mode share are experimenting with innovative treatments to remove snow from bikeways more quickly and effectively than traditional methods. These cities justify utilizing these more effective, but more costly techniques since bicycling is such an essential piece of their transportation system and economies.

10 <http://www.nytimes.com/2013/12/24/us/wisconsin-finds-another-role-for-cheese-de-icing-roads.html>

11. http://epdfiles.engr.wisc.edu/pdf_web_files/tic/bulletins/Bltn_006_SaltNSand.pdf

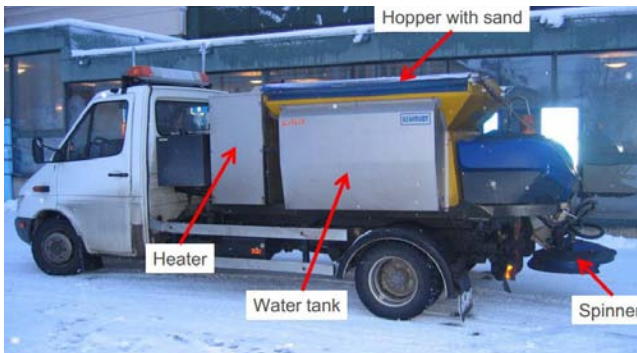


Photo Credit: http://www.ibikeoulu.com/presentations/oulu_2013_warm_wetted_sand_aniska.pdf

Heated Bicycle Paths

The City of Amsterdam recently began testing heated bicycle paths along the city's bikeways. The system works by using geothermal assisted 'asphalt collectors' which collect heat from the bike paths in the summer and store it underground for use in the winter. The move is intended to increase winter safety and ridership – every four weeks that Dutch bikeways remain frozen over in the winter results in approximately 7,000 additional bicycling accidents. The heated lanes are estimated to cost slightly over \$90,000 per mile which may seem costly, but the city will also be saving costs on plowing and de-icing¹².

The town of Umea, Sweden already has approximately 33,000 square meters of heated pathways. These are installed for improved safety on segments of pathways that would be difficult to otherwise maintain¹³.

Warm Wetted Sand

The town of Umea, Sweden is experimenting with the application of warm, wetted sand as an alternative de-icing and traction improvement technique along on-street and off-street bikeways. The material is applied via a specialized truck which contains a water tank, water heater and separate storage for sand. The sand and hot water are mixed upon application and applied via a spreader on the rear of the truck. Initial results have shown that the technique has been effective in both improving traction and reducing surface ice. The benefits of the sand over roadway salt are that it is more environmentally friendly and the sand won't cause corrosion of bike parts. The benefits over dry sand are that the wet sand provides better traction over ice and

12. <http://www.ecf.com/news/dutch-to-heat-cycle-lanes-ecf-newswatch/>

13. http://www.ibikeoulu.com/presentations/marie_frosvinge_umea_winter_cycling_conference.pdf

significantly reduces the amount of sand that sprays on riders and their bicycles¹⁴.

Prioritization

Prioritization and scheduling is a key component of a successful winter bikeway program. For most jurisdictions, keeping all bikeways completely clear during or immediately after a heavy snow event is infeasible. Primary bikeways should be cleared first, providing the best access to the greatest number of people possible following a heavy storm event. Destinations should be taken into consideration as well. If roadway clearing and de-icing begins first thing in the morning, primary routes leading to schools and business districts should be cleared first¹⁵.

In Järvenpää, Finland, Class A routes, the main bikeway routes from residential areas to the city center and through the city center, are cleared first. These are followed by Class B routes, bikeways along other major roads, and Class C routes, those along residential streets and through parks.

- Class A routes are plowed within four hours of 3 centimeters of snow accumulation and de-icing treatments are applied before 7 am. Plowing is done before 7 am when snowing at night.
- Class B routes are plowed within four hours of 5 centimeters of snow accumulation and de-icing treatments are applied as needed. Plowing is done before 7 am when snowing at night.
- Class C routes are plowed after class B routes and plowing is done before 10 am.

Sand and road grit is cleared from Class A, B and C bikeways in Järvenpää every year before the 1st of May.

The Twin Cities area has one of the most extensive greenway networks in the US. Because of the high-level of use the greenways receive for both transportation and recreation year-round, keeping them clear is a high-priority. Typically the greenway network is cleared within 24 hours of a snow event. Trails are cleared to the pavement surface utilizing pickup trucks and/or skid steers¹⁶.

14. http://www.ibikeoulu.com/presentations/oulu_2013_warm_wetted_sand_aniska.pdf

15. http://www.ibikeoulu.com/presentations/winter_maintenance_jarvenpaa_mari_paatalo_13_02_13.pdf

16. Phone interview with Simon Blenski - Bicycle Planner with Minneapolis Public Works Department. January 2014

In 2012, the City of Calgary, Canada upgraded all of their roadways with bike lanes to “Priority I” for snow clearing. Priority I roadways are cleared first following a snow event and receive continuous plowing and de-icing until bare pavement is achieved. All other marked bike routes are considered “Priority II” for snow removal, meaning that they will be cleared 48 hours after the snow stops until bare pavement is achieved. Residential streets are plowed last in Calgary, maintaining a packed surface¹⁷.

The Wisconsin Department of Transportation also offers guidance on the prioritization of snow removal from shared-use paths (Wisconsin Bicycle Facility Design Handbook, 2009 p. A-4, A-5):

Winter use varies according to local conditions. In some communities (e.g. Eau Claire, Madison), paths are plowed regularly and are used frequently by bicyclists and pedestrians. Heavily-used paths that serve key destinations should be considered first for plowing. Even paths that serve only occasional use should be considered for snow removal if the path is the only means of making a key connection (e.g.,

crossing a bridge). Lower priority may be given to isolated paths that serve recreational users who must travel long distances to use them. In these cases, managers may allow want to allow use by cross country skiers or snowmobile operators as long as all applicable laws are followed.

To ensure that winter use is properly accommodated, agencies must clearly understand who will maintain what path. For paths along state highways, a municipality will have the responsibility for maintenance. Winter use and snow removal frequency will be determined by the municipality after considering the following factors:

- *Expected use by bicyclists and pedestrians;*
- *Parallel options for bicyclists and pedestrians if the path is not passable; and*
- *State statute 81.15 regarding the liability for accumulation of snow.*

Case Study: Montreal¹⁸

Montreal has been a North American leader in bicycle network development and bicycling culture for many years. Montreal’s bicycle network consists of over 350 kilometers (approximately 220 miles) of bikeways and was ranked the best bicycle-friendly city in North America by Copenhagenize Design Co. in 2013.

The 2008 Transportation Plan established a “White Network” of priority bikeways across the City that established around 60 kilometers (40 miles) as priority bikeways for snow clearing in the winter. However, now the strategy is shifting to trying to keep as much of the network cleared and open as possible in the winter.

Protected bikeways, some receiving as many as 800 people per day throughout winter months, remain a priority for the City. Typically, curb-separated cycle tracks are cleared with a smaller plow vehicle immediately following street clearing. Montreal receives an average of 80 to 90 inches of snowfall annually, so snow removal must often be implemented as well.

Montreal typically marks their bikeways with standard roadway paint, not thermoplastic. Since thermoplastic is much more expensive than paint, this reduces maintenance costs of bikeway re-stripping from plow blade damage.



View of Rachel Street cycletrack in Montreal, summer (above) and winter (below). Photos courtesy of Bartek Komorowski and Vélo Québec.

¹⁷ <http://www.calgary.ca/Transportation/Roads/Pages/Road-Maintenance/Snow-and-ice-control/SNIC-policy-FAQs.aspx>

¹⁸ Based on January 21, 2014 interview with Bartek Komorowski, Research and Consulting Project Leader with Vélo Québec.

One of the biggest critiques of Montreal's bicycle network is that cycle tracks which are bollard-separated are considered seasonal. Bollards are removed from November 15th to April 1st annually and parking moves into the cycle tracks, eliminating the bikeways throughout these months. However, a new report on Winter Bicycling in Montreal commissioned by the City and developed by Vélo Québec recommends ways for keeping these bikeways operational in the winter such as removing bollards but maintaining the parking restrictions and bikeways.

Conclusion

Cities can expect bicyclists to use the road network year round, even in inclement conditions. It is a city's responsibility to provide safe conditions for bicyclists year round. Strategies and equipment may vary among cities; however, thoughtful roadway design and a strategic bikeway snow removal and de-icing program that includes snow removal prioritization are key to the safe and comfortable accommodation of bicyclists in the winter.



Keeping pathways and bike racks clear of snow for bicyclists is an important mobility consideration. This is especially true in campus settings like the University of Chicago, where the vast majority of students don't own a vehicle.



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