



NORTH DAKOTA

PUBLIC WORKS
WINTER OPERATION PLAN

2019 – 2020

Effective Date: 10/15/2019

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Introduction:

Statement of Purpose:

1. This document has been prepared to help guide City of Dickinson operators and contractors in maintaining City streets, alleys, and parking lots.
2. This document also informs the public of the City of Dickinson guidelines for maintaining City streets, alleys, parking lots, and City owned sidewalks and trails.

Following the plan:

1. This document outlines the guidelines followed for winter maintenance, however, each rain, snow, or ice event is unique and therefore these guidelines may need to be modified to suit the individual event.
1. The travelling public is asked to please be patient – the roadways will be made safe to drive on as soon as possible.

Approval:

Original:

1. This plan has been prepared by the City of Dickinson Public Works Department, and approved by the Dickinson City Commission.

Plan modifications:

1. If necessary, changes to the plan may be made at any time upon approval of the Public Works Director and the City Commission.
2. This policy is also intended to be a working document and should be reviewed at least annually.

Changes since last Operation Plan:

1. This Winter Operation Plan was created new based on the City of Dickinson's previous Snow Removal and Plowing Policy.

Legal:

1. Authority: Authority and responsibility for maintenance of streets, alleys, and parking lots is granted to the Operations Manager by Dickinson Municipal Code Section 33.04.030.
2. The Street Department Manager is responsible for supervision and direction of individual ice and snow control efforts.
 - a. The Operations Manager may designate another employee to supervise these efforts as deemed necessary.

Approval:

1. This Winter Operations Plan has been approved by the Dickinson City Commission.

Exceptions:

1. This Plan does not cover facilities not maintained by the City of Dickinson. These include, but are not limited to:
 - a. Private sidewalks.
 - b. Private roads.
 - c. Private driveways.
 - d. Private parking lots.

Disclaimers:

1. The City of Dickinson is not responsible for the following:
 - a. Windrows across private driveways.
 - b. Windrows across private roads.
 - c. Damage to unauthorized objects within the Right of Way.
 - d. Damage to vehicles parked on the roadway.
 - e. Damage to vehicles entering a closed roadway.

Prohibitions:

1. City operators are prohibited from the following:
 - a. Entering private property.
 - b. Towing or pushing vehicles or equipment not owned by the City of Dickinson.
2. Contractors hired by the City assume all liabilities from the following:
 - a. Entering private property.
 - b. Towing or pushing vehicles or equipment.
 - c. Damages to private property.

Emergency Powers

1. Emergency measures may be enacted by the Public Works Director or his designee as needed. These measures may include but not be limited by the following:
 - a. Declaration of a Snow Emergency.
 - b. Parking restrictions.
 - c. Travel restrictions.
 - d. Road closures.
 - i. Roads may be closed temporarily as stated elsewhere in this plan.
 - ii. The City may abandon low-traffic roads through the winter.
 - e. Designated travel routes.

Mutual Aid

1. The City of Dickinson may enlist the aid of outside agencies, contractors, or individuals as required.
 - a. Compensation will be agreed upon between the City and assisting agency, contractor, or individual prior to commencement of work.
2. Private contractors may be requested to perform snow and ice control as outlined in their agreement with the City.

Jurisdiction:

Service Area:

1. The City of Dickinson maintains City streets, alleys, parking lots, City owned sidewalks and trails within the city limits, and limited roadways outside of city limits based upon agreements with surrounding government agencies, subject to exceptions listed above.
 - a. The service area can be generally described as follows:
 - i. Area of coverage: 10.03 sq mi
 - ii. Climate: Dickinson, North Dakota has a humid continental climate with warm summers and no dry season. Over the course of a year, the temperature typically varies from 6°F to 84°F and is rarely below -16°F or above 95°F
 - iii. Topography: Rolling plains. Generally gentle hills, with a few steeper hills.
 - iv. Population: 25,000 – 30,000

Road System Classification and Priorities:

Classification:

1. Roadways within the City of Dickinson Jurisdiction are classified as follows:
 - a. Arterial: Principal arterial streets are designed to move vehicles through and beyond an urban area with access typically limited to only include side street intersections. These roads have limited access, higher speeds and traffic signals at major cross streets. Arterials are generally spaced about two miles apart. Minor arterials are designed to serve traffic across an urban area with some limited access. These roads typically have cross street access, with limited driveway access, medium speeds and signalized intersections at major cross streets
 - b. Collector: Collector streets are designed to connect local streets to arterial streets, but are not typically designed for long distance travel. These roads usually provide some level of street or driveway access and facilitate slower speeds, generally 35 miles per hour or slower. Collectors have less vehicle capacity than arterials and major collectors, but more capacity than local streets.
 - c. Local: Local streets are designed to offer access from adjacent property (they can also be in commercial, industrial and rural areas) to the roadway network. Urban local streets connect driveways to collectors or arterials. Local streets are typically laced with driveways on both sides and have posted speed limits of 25 miles per hour or less. Typically, local streets represent the largest share of roads in a community.
 - d. Downtown: The area bordered by Villard Street to the south, 3rd Street to the north, 4th Avenue West to the west, and 4th Avenue East to the east.
 - e. Alleys: Provide access to the rear of properties in a portion of the downtown area and the older section of the city (generally). Alleys are generally designed for low speed and low weight bearing capacity.

- f. Snow Emergency Routes: Designated Arterial and Collector roads, along with other designated roads as necessary to facilitate emergency traffic.

Priorities:

1. In order to make the most efficient use of available resources, the City has established priorities using the assumption that the severity of a storm is not beyond the normal capabilities of the City’s snow removal resources. Depending on the nature of the snowstorm, deviations could occur.
2. Maintenance priorities are assigned to each roadway based upon applicable Federal, State, and Municipal laws. Generally, roadways are assigned the following priorities, although some deviation may be made to maintain accessibility for the greatest number of drivers. Ideally the City would prefer all roads to be in the ‘Good’ Level of Service category at all times, however, due to equipment and manpower limitations, the Level of Service Goal for each Priority level is set for the period during and shortly after each snow event.
 - a. Level One: Level of Service Goal: Good
 - i. Roads funded by Federal and State funds (generally arterial roads).
 - ii. Roads leading to Emergency Services facilities.
 - b. Level Two: Level of Service Goal: Fair
 - i. Collector roads (generally).
 - ii. Roads surrounding schools.
 - c. Downtown Area: Level of Service Goal: Fair
 - i. Generally the area bordered by Villard Street to the south, 3rd Street to the north, 4th Avenue West to the west, and 4th Avenue East to the east.
 - d. Local: Level of Service Goal: Acceptable
 - i. Remaining roads in residential areas.
 - ii. Remaining roads in commercial and industrial areas.
3. A Snow Priority Route map showing the assigned priorities of roadways is included as Attachment 1.

Levels of Service

LOS definition:

1. Level of Service, in the context of winter road maintenance, explains the type of metric used to determine how a road is maintained using winter maintenance practices. LOS is used to indicate the degree of effort to achieve an acceptable level of road surface condition for winter travel, byproducts of which are safety and mobility.
2. When setting the Level of Service the City of Dickinson must balance societal needs, economic constraints, and environmental stewardship.

Measuring and Quantifying LOS:

1. Visual assessment of pavement conditions.
2. Visual determination of the time pavement area is snow/ice covered compared to the total storm time.

Description of LOS for each priority/classification:

1. Good:

- a. Roads in “good” condition consist of bare pavement, either dry or wet, with clearly visible pavement markings. Tactics to achieve “good” conditions include anti-icing, deicing, and plowing during and after the storm, and use of abrasives in spot locations. Maintenance is conducted throughout the storm and normal roadway conditions are restored as quickly as possible after snowfall cease. Below are examples of “good” road conditions.



2. Fair:

- a. Roadways in “fair” condition consist of intermittent bare pavement and markings, with wheel paths clear in at least one lane in each direction. Tactics to achieve “fair” conditions may include anti-icing, deicing, and plowing during and after the storm, and abrasives may be applied in spot locations. Maintenance is conducted during the storm as resources permit, and efforts are made to restore these routes to normal conditions after snowfall ceases. Less funds are spent on labor, fuel, materials and equipment. However, in comparison to “good” condition, drivers may experience increased stress, safety concerns and decreased mobility. Below are examples of “fair” road conditions.



3. Acceptable:

a. Roadways in “Acceptable” condition consist of intermittent wheel paths in one lane in each direction. Fewer resources are expended, with most efforts focused on snow clearance and material treatment after the storm. Abrasives may be applied in spot locations where additional traction is needed. Routes of this ranking are often low volume roads and streets. Maintenance is conducted on a limited basis during the storm as resources permit, and efforts are made to restore these routes to normal, conditions within a reasonable time period following a storm. Routes maintained in “Acceptable” condition do provide adequate mobility for prudent drivers with properly equipped vehicles, and cost significantly less to maintain. The traveling public will likely experience increased stress, safety problems and decreased mobility on these routes. More effort is required to restore the route to a normal condition following the storm; this effort is conducted during normal operating hours thus minimizing overtime costs. Below is an example of “Acceptable” road conditions.



4. Black Ice:

a. Black ice is a condition where the road may appear to be in “Good” or “Fair” condition, but a very thin, mostly invisible layer of ice is present. This presents a significant hazard to drivers, particularly when it is encountered unexpectedly. Treatment of black ice can include the use of chemicals or abrasives for melting and to enhance traction. Below are examples of “black ice” road conditions.



General Strategies and Tactics

Basis for Winter Operations Plan:

1. The City of Dickinson does not have a bare pavement policy for snow and ice control, but rather has a policy of providing practical, safe access to homes, businesses, public buildings, and medical facilities.

General approach to snow and ice control based on **typical** conditions:

1. Pre-storm: Pre-treat roads with anti-icing solution based on predicted precipitation, temperatures, and other factors.
2. During storm: Plow snow, apply de-icing materials as required following the road priority ratings. Depending on the severity of the snowfall, roads other than Priority One and Two may not be plowed until after the snowfall stops.
3. After storm: Finish snow plowing and de-icing operations. Haul snow from any roads that may need it.

Areas requiring special attention:

1. Hills
2. Bridges
3. Cul-de-sacs
4. High traffic areas with special conditions

Anti-icing and de-icing explained:

1. Anti-icing: A proactive approach to ice control, anti-icing involves applying a small amount of brine to the road surface prior to the beginning of snowfall. The amount applied varies depending on the expected precipitation amount, temperature, and other factors. An average application is approximately 45 gallons per lane mile of road, which equates to about 2 cups of salt covering an area the size of a basketball court, or about 22 cups of salt covering a football field.
2. De-icing: A reactive approach to ice control, de-icing involves applying salt in either liquid or solid state to the road surface to melt through the ice and break its bond with the pavement. The amount varies depending on the amount of ice accumulation, temperature, and other factors. An average application is approximately 250 pounds of salt per lane mile of road, which equates to about 5 cups of salt covering an area the size of a basketball court, or about 48 cups of salt covering a football field.

Commitment to Safety

1. The City of Dickinson aims to maintain safe driving conditions for motorists, but must also consider the safety of the operators.
2. Snow and ice control efforts may be suspended if conditions are unsafe to continue. They will resume when it is safe to do so.

Commitment to Sustainability

1. The City of Dickinson attempts to balance the need for safe travel with the commitment to protect the environment. This involves many factors including proper storage facilities, sound material handling and application, and removal of sand, dirt, and other materials from the road surface to minimize them from entering the environment.

Snow Emergency

Definition:

1. A Snow Emergency may be declared based on falling snow, sleet or freezing rain or upon the basis of the forecast of the same. Upon its declaration, a snow emergency shall remain in effect until it has been officially terminated.

Declaration:

1. A Snow Emergency may be declared by the City Administrator, City Public Works Director, Operations Manager, or Chief Street Maintenance Operator after consulting with the City Public Works Director or City Administrator.
2. A Snow Emergency may be declared when weather conditions and snow accumulations require snow removal operations, and those operations would be hindered by vehicles parked on the roadway.

Public Announcements:

1. The declaration or termination of a Snow Emergency will be publicly announced by any or all media, internet, or social media available.
2. The following examples of announcements may be used as a guideline:
 - a. **Announcement of Snow Emergency Declaration**

Due to storm conditions, the City of Dickinson has declared a Snow Emergency. To aid in snow control efforts, the parking of vehicles along Snow Emergency Routes is prohibited. Citizens are requested to remove their parked vehicles from Snow Emergency Routes as soon as possible. Snow Emergency Routes are shown on the “Snow Emergency Routes” map posted on the City of Dickinson website. Vehicles parked on Snow Emergency Routes are subject to parking citations and towing without notice, at the owner’s expense.

To aid in the safe and efficient snow control effort, drivers are requested to provide a safe interval of at least 100 feet between their vehicle and snow control equipment. Drivers are also requested to not pass operating snow removal equipment.

Citizens are encouraged to stay home until storm conditions subside.
 - b. **Announcement of Termination of Snow Emergency**

The City of Dickinson has terminated the recently declared snow emergency. Citizens may resume parking their vehicles along Snow Emergency Routes. The City of Dickinson wishes to thank the people of the City for their cooperation and understanding during the snow emergency.

Definition of Snow Emergency Routes:

1. Certain streets under the City of Dickinson jurisdiction that may be necessary for Emergency Services and the general public to travel on for vital or emergency purposes.
2. General designation of streets to be designated as Snow Emergency Routes:
 - a. Major Arterials
 - b. Minor Arterials
 - c. Access to Emergency Services
 - d. Collector roads
 - e. Other streets deemed necessary to minimize travel distance to an Arterial Route. This distance is generally no more than ½ (one half) mile.
3. Types of streets not subject to designation as Snow Emergency Routes:
 - a. Downtown area
 - b. Area around schools
 - c. Business or industrial districts
 - d. Residential areas

Identification:

1. Snow Emergency Routes are identified on the map included as Attachment 2 and posted on the City of Dickinson website.
2. Snow Emergency Routes may be signed following these guidelines.
 - a. Signs should be placed with at least 1 sign per block in both directions of travel, with a maximum distance between signs of 300 feet.
 - b. Signs do not need to be placed on portions of streets that are designated No Parking zones.
 - c. Signs do not need to be placed on streets that do not have parking lanes or only have shoulders for emergency stopping.

Public Actions:

1. Upon the declaration of a Snow Emergency, all vehicles must be removed from the designated Snow Emergency Routes.
 - a. Vehicles remaining on the Snow Emergency Routes will be subject to impoundment at the owner's expense.

City Actions:

1. Upon the declaration of a Snow Emergency, work crews shall concentrate their snow control efforts on Snow Emergency Routes, with Level One routes receiving the highest priority. Portions of level Two routes and general city streets may be plowed as the equipment moves to their next assignment or as designated by the Operations Manager or other designated personnel.
 - a. During Emergency Snow Removal operations crews will attempt to keep streets passable. It may be necessary to return after all initial plowing operations are complete to finish clearing the streets. These operations may affect traffic flow. The public's patience is requested during these times.
 - b. Once the Snow Emergency Routes have been opened, general snow control efforts on the remaining street system may begin if conditions warrant.

Weather Information Sources and Decision Process

1. The Operations Manager is responsible for monitoring weather forecasts to assure that adequate supplies, equipment, and labor is available to meet the ice and snow control needs of the City prior to the onset of an approaching storm.
2. The Street Department will utilize forecasts from various sources to monitor the weather.
3. Weather reports from other City of Dickinson departments, and other government agencies, such as the Dickinson Police Department, Stark County Emergency Management, ND Department of Emergency Services, and ND Department of Transportation, will be scrutinized to discern any actions required.
4. The final decision on actions to be taken lies solely with the Street Department.

Route Optimization

1. Snow removal and ice control routes are reviewed and updated on a regular basis.

Media and Public Relations:

1. All information regarding winter operations will be disseminated by the designated Public Information Officer.
 - a. The designated Public Information Officer will use any or all media, internet, or social media available.
 - b. The reverse 911 system and/or Dickinson Works may be used when it is deemed necessary and helpful.

Customer Service:

Handling inquiries, requests, complaints:

1. All requests should be routed to the Administrative Assistant for Public Works, who will forward them to the appropriate Street Department personnel. Citizens may call the Public Works Facility at 456-7979. If you reach our voicemail during business hours and/or after hours, please leave your **name, number, address of concern, and nature of your call**. Our office will submit a service request for you as quickly as possible.
2. Street Department personnel shall investigate all requests and determine the appropriate action.
3. Requests will be prioritized by Road Classification, Level of Service, and actual conditions.
 - a. Emergency and/or Life Safety requests will receive attention as required.

Citizen information:

1. Direct public access to information relating to winter operations status is not available at this time, but is being researched.
2. Citizens are urged to visit the 'Dickinson Works' page on the City of Dickinson web site or to download the 'Dickinson Works' smart phone app to receive announcements and updates on snow removal efforts.
3. The public is encouraged to follow Public Works information on the City of Dickinson website and social media.

4. Property owners are responsible for snow and ice control on their property. The City operators attempt to minimize the size of windrows placed in front of driveways and mailboxes, but there will normally be some snow the property owner must remove.
 - i. Property owners are advised to become familiar with Dickinson Municipal Code Sections 33.04.290 and 11.12.010, which relate to snow and ice control by property owners.

Documentation and reports:

1. The City of Dickinson reviews materials used and maintenance hours expended throughout the year to improve performance and environmental stewardship.

Financial:

1. Material and operation costs are included in the City of Dickinson annual budget.
2. The City of Dickinson solicits costs of materials and services annually in an attempt to keep costs as low as possible for the citizens.

Organization:

1. The Public Works Department organization is set forth in the City of Dickinson Organizational Chart.

Personnel:

1. All Street Department employees are subject to ice and snow control duties as part of their job duties.
2. Fleet Maintenance employees may be subject to extended and/or modified work schedules to ensure maintenance shop coverage.
3. Buildings and Grounds employees are subject to ice and snow control duties on designated City buildings and sidewalks as designated on the Sidewalks Map included as Attachment 4.
4. During a snow emergency, all qualified City employees shall be subject to ice and snow control duties unless other emergency situations arise which require their attention elsewhere.
5. The Street Department may hire additional employees as needed to augment the labor force necessary to mount and sustain an ice and snow control effort.
6. The City of Dickinson supplies high-visibility outerwear to be worn whenever the operator is outside of their vehicle or equipment on the road system.
7. Rest and meal breaks are taken according to the City of Dickinson Municipal Code. During extended operations meals may be provided by the City of Dickinson and served at the Public Works Facility. This allows time for the employees to get some rest, eat a balanced meal, and confer with supervisors and other operators to formulate plans for continuing operations.

Training and Certification:

1. City operators will receive training on snow and ice control techniques prior to the winter season.
2. City operators must be qualified according to the Street Department training program prior to operating City equipment.

- a. Some specialized equipment requires additional training in techniques and use of control systems.
- 3. Required training is listed in the following chart:

Training	Presented By	Frequency
Annual driver training	Senior staff	Annually
LTAP Winter Roads Maintenance Workshop	LTAP	Once
Annual updating of winter maintenance routes	Senior staff	Annually

- 4. References available to operators:
 - a. Snow route map book.
 - b. Ice control product use guide.

Fleet:

Vehicles, Equipment, and Machinery

- 1. The Public Works Division maintains a fleet of equipment appropriate for use in ice and snow control operations. Citizens desiring specific information on the equipment available may request a list of the equipment from the Public Works Division.

Public Works equipment:

- 1. During a snow emergency, all Public Works equipment shall be made available to the ice and snow control effort unless other emergency situations arise which require their use elsewhere.

Contracted equipment:

- 1. The Street Department may contract additional equipment and personnel as needed to augment the equipment fleet necessary to mount and sustain the ice and snow control effort.
- 2. Private contractors may be requested to perform ice and snow control as outlined in their agreement with the City.

Facilities:

Equipment storage and maintenance facility:

- 1. Snow and ice control equipment is stored and maintained within the City of Dickinson Public Works Facility.
- 2. Quick-tach snow plows are stored adjacent to the material storage building.
- 3. Equipment is washed in the wash bay of the Public Works Facility. Runoff flows through a sand/oil separator, then into the sanitary sewer system.

Ice control storage facility:

1. Materials are stored in a covered building. Runoff flows to floor drains in that building then to a closed tank. This water is used in the brine-making process or pumped into the sanitary sewer system for treatment.
2. Materials are unloaded and stockpiled within the storage building to prevent them from contaminating the surrounding area.

Brine production facility:

1. Brine is produced in a heated, enclosed room attached to the material storage shed.
2. Brine and additives are stored in tanks contained within a containment structure adjacent to the production room.
3. Brine truck loading area includes floor drains which flow to a closed tank. This water is used in the brine-making process or pumped into the sanitary sewer system for treatment.

Power loss:

1. In the event the facilities lose electrical power, emergency generators are installed to automatically come on line and supply all normal electrical needs.

Communications:

1. Snow and ice control operation communications are conducted using the City of Dickinson's business band radio system.
2. In the event the radio system fails the City of Dickinson may utilize cell phone communications if available, or a courier system.
3. In the event of a multi-agency response, the ND State digital radio system will be used to coordinate with outside agencies.

Materials:

Choice of material:

1. Material application best practices consist of selecting the most effective snow and ice control material for a given road weather scenario combined with the most efficient application method to minimize loss of material, costs, application rates, and frequency of applications. The City of Dickinson has the following options available:

Salt:

1. Salt (Sodium Chloride) is used to melt ice and to make brine.
2. Usable range:
 - a. Effectiveness drops with temperatures below 25°F.
 - b. Pre-wetting lowers the effective range (see pre-wetting section below).
 - c. Below 0°F a sand/salt mixture may be used to provide traction until the salt is able to melt the ice.
3. Source:
 - a. For direct application to the roadways the City of Dickinson 'piggybacks' on the NDDOT contract for mined salt.

- b. Salt used for brine production must be made up of larger grains and contain minimal impurities. Solar salt is used for this purpose.
- 4. Application rates:
 - a. Based on the amount of ice build-up. Generally between 100 and 550 pounds per lane mile.
- 5. Storage:
 - a. Salt is stored in a covered building. Runoff flows to floor drains in that building then to a closed tank. This water is used in the brine-making process or pumped into the sanitary sewer system for treatment.
- 6. Additives:
 - a. At this time the City of Dickinson does not use salt additives.

Brine:

1. Brine consists of water with approximately 23% dissolved salt content. Studies have shown brine usage may reduce total salt usage by 25 – 40% over the course of the winter compared to using granular salt only.
2. Usable range:
 - a. Brine is effective to approximately 10°F.
 - b. Additives may lower the usability to as low as -20°F, depending on the concentration.
3. Source: Brine is produced on site at the Public Works Facility.
4. Storage: Brine is stored in tanks located within a containment structure adjacent to the brine production facility.
5. Additives: Agricultural byproducts may be used to increase the effectiveness of the brine.
 - a. Additives lower the usable temperature of the brine.
 - b. Additives, being sugar-based, lower the corrosiveness of the brine.
 - c. Additives may be used in concentrations up to 25% by volume depending on outdoor temperature and road conditions.
6. Advantages: Allows for better road conditions during the snow event, reduces total salt applied to roadways, frees up equipment to work in other areas (increased efficiency), reduces maintenance cost for the snow event, treatment may last up to a week or more if the predicted snow event fails to materialize.
7. Usage: Brine may be used in several ways:
 - a. Anti-icing: This is a proactive approach to ice control. Depending on weather forecasts, road conditions, and other factors, brine may be applied to road surfaces prior to the arrival of precipitation. This application helps prevent snow and ice from bonding with the pavement, thereby making for safer driving conditions and easier removal. Application rates may vary, but the general starting rate is 45 gallons per lane mile. This equates to less than 1 ounce per square yard.
 - b. Pre-wetting: Uses a small amount of brine to make the dry granular material wet. This approach has two purposes:
 - i. Help the material stick to the roadway.

- a. Studies have shown that as much as 30% of dry material does not remain on the roadway. It either bounces and scatters or is blown off the road surface into the gutter or ditch. This results in the need to apply more material, and also leads to excessive amounts of material collecting on the roadside and possibly entering waterways.
 - ii. Give the salt a jumpstart on melting ice.
 - a. Dry salt granules may take several minutes to begin melting ice. Pre-wetted granules begin melting immediately.
- c. De-icing: This is a reactive approach to ice control. Normally brine is used as a pre-wetting agent for de-icing, but brine may also be applied directly to the road surface. Refer to the Pre-wetting and Direct liquid application sections for details.
- d. Direct liquid application: Depending on the amount of snow falling, liquid brine may be applied to the road surface during a snow event to prevent the snow from turning to ice and bonding to the road surface. This method may reduce the time for the road surface to return to bare pavement and may be considerably more cost effective. For de-icing purposes, direct liquid application has limited uses.
 - i. During a snow event:
 - a. Application rates vary depending on the amount of precipitation, but may be up to 100 gallons per lane mile. As the brine solution is diluted, more needs to be applied to maintain its melting power. The reapplication interval will vary, but generally will be every 1 ½ to 2 hours.
 - ii. De-icing purposes:
 - a. Application rates vary depending on the amount of ice and compacted snow, but may be up to 100 gallons per lane mile. Liquid application must be followed up by plowing after allowing the liquid to penetrate the ice or snow and break the bond between the ice or snow and pavement.

Sand:

1. Sand is an abrasive granular material that has no ice melting abilities. It is used strictly to provide a temporary friction layer. It is relatively inexpensive, but the damage caused by repeated applications, along with substantial clean-up costs, make it less cost-effective. The use of abrasives can negatively impact water quality and aquatic species, air quality, vegetation, and soil, and therefore incur hidden costs. Even after cleanup, 50% to 90% of the sand may remain somewhere in the environment. Abrasives also pose significant risks for water quality and may threaten the survivability of aquatic species especially during spring runoff.

2. Usable range: May be used at any temperature, but is generally reserved for use below 0°F, when salt is less effective.
3. Source: Washed sand is purchased from a local supplier.
4. Application rates: Based on the amount of ice and snow build-up. Generally between 200 and 1000 pounds per lane mile.
5. Storage: Sand is stored in a covered building. Runoff flows to floor drains in that building then to a closed tank. This water is used in the brine-making process or pumped into the sanitary sewer system for treatment.
6. Additives: Approximately 10 - 20% salt is added to prevent the sand from freezing.

Pre-season activities:

1. The Operations Manager is responsible for the annual preparations necessary to assure that adequate supplies, equipment, and labor are available to meet the ice and snow control needs of the City prior to the onset of and throughout the winter season.
 - a. Inspect equipment to ensure it is serviced and ready to perform.
 - b. Ensure an adequate supply of consumable parts for the equipment.
 - c. Inspect brine production, storage, and loading facilities to ensure they are ready to perform.
 - d. Reach agreements with suppliers of materials and contractors.
 - e. Evaluate areas prone to high snow accumulation for possible snow fences or snow windrowing.

Post-season activities:

1. Equipment is inspected for needed repairs.
2. Painted surfaces are cleaned, primed, and re-painted to minimize corrosion during the off-season.
3. Streets are swept to remove dirt, sand, and rubbish that has collected throughout the winter season. Pickup sweepers use water as a dust control agent, but due to the large amount of fine material, dust stirred up by sweepers is to be expected. Side-delivery sweepers do not have water systems for dust control and therefore create dust clouds. These sweepers are generally only used on roads without curbs in commercial, industrial, and remote areas.

Operations:

Initiation of Operations:

1. Ice or snow control operations may be initiated by:
 - a. Public Works Director
 - b. Operations Manager
 - c. Chief Street Maintenance Operator

Ice control:

1. Anti-icing: Anti-icing is a pro-active approach to winter road maintenance. It involves the application of anti-icing products (also known as freeze-point depressants) to the roadway before a winter storm. It forms a bond-breaker between the pavement

surface and the snow and ice layer which melts snow more quickly and reduces the chance that ice will form and bond to the surface. It is similar to how cooking oil prevents food from sticking to the frying pan.

2. De-icing: De-icing is the application of granular and liquid materials after snow and ice has compacted to the roadway. It takes approximately three times the resources to remove compacted snow and ice when the anti-icing process is not used.
3. Pre-wetting: Pre-wetting is the application of liquid to a granular salt mixture prior to the salt being placed on the roadway to help jump start the melting process. Sand alone cannot melt snow and ice, and dry salt must change into a liquid solution to melt snow and ice. Studies have shown up to 30% of dry salt or sand can scatter or blow off the roadway, so liquid is added to the salt mixture to prevent scattering and blowing, helping the salt mixture stay on the roadway.
4. Variables used to determine if, when, where, and what type of ice control operations will commence are air temperature, wind speed, precipitation type and intensity, current pavement conditions, location, and the experience of our maintenance crews.

Snow control:

1. Snow control efforts include plowing, blowing, and hauling of snow and may also include ice control efforts.
2. Variables used to determine if, when, where, and what type of snow control operations will commence are air temperature, wind speed, precipitation type and intensity, current pavement conditions, location, and the experience of our maintenance crews.
3. Generally the City will strive to keep Level 1 and Snow Emergency routes passable during snowfall.
4. Plowing activities may commence after the snowfall has stopped.
5. Residential streets will be evaluated for snow removal once snow has accumulated to 4" or more.

Plowing procedures and techniques

1. Snow will be moved from the street surface to windrows. Generally these windrows will be along both curbs, with the following exceptions:
 - a. Boulevards have been designated as snow storage. In areas with boulevards the windrow will be pushed over the curb onto the boulevard.
 - b. Sections of streets that do not have driveways on both sides may have all snow windrowed to the side without driveways.
 - c. Snow may be hauled from certain streets. Generally the snow is windrowed to the center of the roadway, but depending on circumstances may be windrowed to the curbs temporarily, then pulled to the center when crews are available to haul the snow.
 - d. Plow operators will attempt to minimize snow on sidewalks, driveways, and in front of mailboxes, but this is not always possible. The City is not responsible for removing snow on sidewalks or driveways. This is the responsibility of the property owner, as stated in Dickinson City Code Section 33.04.290.
 - i. Should large volumes of snow make it impractical to avoid placing snow on sidewalks, the sidewalks may be abandoned by order of the City Administrator or City Public Works Director.

- ii. Plow operators will remove as much snow as possible during plowing operations, but removing packed snow requires extra time, which lengthens the time needed to open roads throughout the city, therefore compacted snow will be treated with ice control materials. Compacted snow may be removed as crews have time after all snow and ice control efforts are complete.
- 2. Streets will generally be plowed following the Road Classification and Priorities section.
 - a. Once all city streets have been cleaned, operations will move into alleys if necessary. A front-end loader will make one pass through the alleys. Any snow accumulations outside the loader path will be the responsibility of the adjacent property owner. Except for emergency situations the alleys will be cleaned last.
- 3. In order to maintain even wear on cutting edges plow operators may travel against the flow of traffic. They will refrain from this practice on major thoroughfares if possible.
- 4. Plow operators may travel against the flow of traffic in order to move the snow to one side. If this is necessary they will allow traffic to pass them, either by stopping until traffic is past or by moving the plow out of the traffic lane until traffic is past.
City crews will close the Street or Road to traffic if removal of snow will create an unsafe situation.
- 5. The Street Department may temporarily close a street which has been blocked with snow. Such a street closure shall take place only when:
 - i. Crews are attempting to clear the blockage.
 - ii. The time necessary to clear the blockage is so long that the clearing of other streets becomes a higher priority.
- 6. All plow equipment will operate with lights and strobe lights operating day or night.
- 7. City vehicles and equipment, or contracted vehicles and equipment, will not place snow on private property except as authorized by Street Department supervisory personnel.

Safety concerns:

- 1. Safety concerns, such as zero visibility, will dictate plowing operations. It may be necessary to suspend operations in certain areas of the city until it is safe to resume. City crews will respond to verified emergencies where possible.

Snow hauling:

- 1. As a general policy, snow removal in the downtown area and other designated snow hauling routes will commence during the first night following the end of the snowfall.
 - a. This policy may be modified based on the amount of snow city-wide, availability of equipment and personnel, and other factors.
- 2. Streets have been designated for snow hauling because they meet the following criteria:
 - a. Major thoroughfares on the Federal Aid system which do not have anywhere to store the snow.
 - b. Downtown area which may need to be hauled to allow room for customer parking.
 - c. School zones where there is nowhere to store snow while ensuring the safety of students, parents, and school personnel.

3. Work crews may add or subtract from this list as conditions may require.
4. The Street Department will attempt to minimize traffic disruption by hauling snow during times when there is less traffic, however that may not always be possible. The public is asked to please be patient.
5. Streets designated to have snow hauled from them are identified on the Snow Hauling Route map included as Attachment 3.

Snow Storage Sites

1. The Operations Manager shall be responsible for locating suitable snow storage sites.
2. The policy of the City of Dickinson is to not push, haul, or pile snow on vacant lots, unless absolutely necessary and approved by the Public Works Director, Operations Manager, or Chief Street Maintenance Operator.
3. Snow may be piled on boulevards, as they are the property of the City of Dickinson.
4. Contractors must obtain permission from dump site landowners before hauling snow to dumpsites.
5. Contractors may not dump on any City or Park District property or dump sites without permission from the Street Department.
6. Contractors are responsible for stockpiling any snow they haul to dump sites, along with the cleanup of debris at those sites after the snow melts.
7. Snow storage sites are identified on the Snow hauling route map included as Attachment 3.

Sidcasting snow

1. Certain roadways benefit from sidcasting the snow onto adjacent public properties by using a rotary snowblower. This action removes windrows which accelerate snow buildup on the driving surface. These roadways will be identified by Street Department personnel based on past, current, and predicted snowfall, wind, and temperatures.

Actions:

Pre-storm

1. Equipment:
 - a. Ensure equipment is properly configured, calibrated, and ready to use.
2. Ice Control
 - a. Ensure there are adequate stocks of ice control materials.
3. Snow Control
 - a. Ensure equipment is ready to use.

During Storm

1. Operations:
 - a. As conditions can rapidly and unexpectedly change as a storm progresses, operations managers and supervisors must respond quickly and accordingly. Flexibility and adaptability are critical for keeping roadways safely passable and with the efficient and effective use of materials with the least detriment to the environment. Many factors, principal among them current air and pavement temperatures, pavement moisture, traffic activity, application rate,

and type of material, determine how fast melting occurs. In addition to those factors, managers need to assess rate (intensity) and type of snow-fall (dry vs. wet), projected duration and final accumulated snow-fall total, forecasted temperature direction (increase or decrease) and wind speeds, traffic volume until the end of the storm, micro-climate problems caused by topography and the availability of equipment and operators.

2. Equipment:
 - a. Equipment breakdowns not only slow down operations, but also may cause safety issues. Fleet Maintenance personnel may be called upon to assist operators in returning equipment to operation in a timely fashion.
 - b. A limited number of standby equipment may be available to replace the primary equipment until it is returned to service.
3. Ice Control
 - a. Ice control materials are less effective when there is an accumulation of snow. Therefore ice control operations may be delayed or suspended until the snow is either plowed from the road surface or become compacted, at which time ice control materials are again applied to assist in returning the road surface to its designated Level of Service.
 - b. The effectiveness of salt drops as the temperature drops. A mixture of sand and salt will be utilized at these lower temperatures to provide traction for motorists until the temperature rises to a point where salt is once again effective.
2. Snow Control
 - a. Snow removal efforts will be undertaken in an attempt to maintain safe driving conditions for the traveling public.
 - b. Snow removal efforts will begin with Level One roads and Emergency Services access, then progress to Level Two and remaining roads, unless the snowfall requires the equipment to remain on higher level roads to maintain them in the safest possible driving condition.

Post –storm

1. Operations:
 - a. Snow and ice control operations will continue once the storm has passed to return roads to their designated Level of Service as a minimum.
 - b. Snow may be hauled from designated areas or other areas depending on several factors, such as the amount of accumulated snow, traffic levels, areas prone to ice formation, and others.
2. Equipment:
 - a. Salt spreaders are emptied and washed to minimize corrosion, reduce wear on the equipment, and expose possible maintenance issues with the equipment.
 - b. Plow equipment is washed to minimize corrosion, reduce wear on the equipment, and expose possible maintenance issues with the equipment.
 - c. Washing takes place in an indoor wash bay and the runoff is directed into the sanitary sewer system for treatment.

3. Ice Control
 - a. Ice control efforts may continue after the storm passes in an attempt to return all roads to a safe driving condition.
4. Snow Control
 - a. Once the storm has passed snow removal operations may continue in an effort to return all roads to a safe driving condition.
 - b. These operations may include plowing, hauling, opening storm sewer inlets and other water channeling features.

Contingencies:

Ice storm and debris clearance

1. Efforts may be coordinated with multiple City Departments along with outside agencies.

Blizzard

1. Blizzard conditions may require extra measures to ensure the safety of employees and the motoring public.
2. A complete travel ban may be ordered within the city limits.
3. Equipment may be dispatched with multiple employees to increase their safety.
4. If conditions warrant, equipment may be pulled from snow control efforts until conditions improve.
5. Employees may be housed and fed at the Public Works Facility to ensure their availability when operations begin.

Increased accumulations from successive storms

1. As snow accumulates from multiple storms the City of Dickinson may find it necessary to vacate sidewalks, parking lanes, or other areas to accommodate snow storage needs.

Flooding caused by ice-jams

1. The City of Dickinson will coordinate with the Stark County Emergency Management Office and other agencies to mitigate flooding damage.

Shortage of material

1. The City of Dickinson strives to maintain adequate supplies of materials.
2. In case of higher than normal demand and extended delivery times, the City of Dickinson will utilize all means necessary to replenish supplies.

Loss of facilities

1. In the event the use of normal facilities is lost, equipment and personnel will be transferred to any available facilities, whether owned by the City of Dickinson, another government agency, or private individuals.

Attachments:

1. Snow Priority Route Map
2. Snow Emergency Route Map
3. Snow Hauling Route Map
4. Sidewalks

References:

1. Climate information: <https://weatherspark.com/averages/30051/Dickinson-North-Dakota-United-States>
2. Area size: https://en.wikipedia.org/wiki/Dickinson,_North_Dakota
3. Population: <http://www.dickinsongov.com/>
4. Anti-icing: <https://www.dot.nd.gov/divisions/maintenance/docs/anti-icingfacts.pdf>
5. Authority and Responsibility for maintenance: Dickinson City Code 33.04.030.
6. Power to require snow removal from sidewalks:
<http://www.legis.nd.gov/cencode/t40c05.pdf#nameddest=40-05-01>
7. Snow Emergency: Dickinson City Code 23.56.190, 23.56.200, 23.56.210, 23.56.220, 23.56.230, 23.56.240
8. Best Practices Manual <http://clearroads.org/download/best-practices-manual-2/>
9. Snowfighter's Handbook – Safe and Sustainable Snowfighting
<http://www.safewinterroads.org/snowfighters/>