INFORMATION ITEM
MEMORANDUM

To: Mayor and Members of Council

From: Nuria Rivera-Vandermyde, City Manager
Natalie Stiffler, Director of Transportation & Mobility
Scott Schlecht, Transportation Maintenance Manager
Daniel Sheeter, Principal Transportation Planner
Ben Manibog, Senior Project Manager

Date: December 21, 2023

Subject: Information Item: Update on Snow and Ice Response Review Project

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EXECUTIVE SUMMARY

This report provides the City Council with an overview of the Transportation & Mobility Snow and Ice Response Review project and current community engagement activities.

The project's purpose is to review the City of Boulder's Snow and Ice Response program's service, understand the community's preferences and needs, understand industry service levels, and consider program changes to better meet goals and expectations.

Staff heard through engagement that the program should be more aligned with the mode share objectives in the Transportation Master Plan (TMP), focus on equity, and improve its communication to the public.

The project's recommendations categorize the city's response to snow and ice based on the size of the snow event. Data-driven criteria were created for the city's streets, multi-use paths, bike network and shoveled areas (bus stops, crosswalks, and pedestrian refuges) to prioritize snow clearing response.

The project began in Fall 2022 and is expected to be completed in early 2024. Following feedback on the project's draft recommendations from community, staff will review if elements of the recommendations can be implemented this winter without changes to budget. Additional funding to implement program recommendations will be requested from City Council through a

formal budget development process in 2024 for the 2025 budget year. Implementation may occur in the 2024/2025 snow season at the earliest.

FISCAL IMPACT

Following feedback from the TAB and community engagement, staff will adjust the recommended framework of the snow and ice program. Staff will use the framework to form a 2025 budget request.

The Snow and Ice Response program is managed by the Transportation & Mobility Department, with an adopted 2023 budget of $1.84M. The annual budget is developed each year for predicted average weather patterns and events.

One or more significant snowfall events, or extenuating circumstances, can increase costs more than those allocations. If additional funding is required, reserves can be allocated through the city's supplemental appropriations process. In addition to the T&M Department budget, the Boulder Police Department accounts for costs involving sidewalk snow removal enforcement.

Clearing snow and ice from the city's infrastructure requires snowplows, staff to operate the plows, and additional contractors to clear shoveled areas.

After finalizing a recommended program framework, staff will estimate the implementation costs based on industry best practices. To give order-of-magnitude examples, large snowplows cost between $350,000 - $480,000. Large plows also have a usable life of seven years and can efficiently clear up to 25 lane miles of streets depending on the assigned route. Each snowplow needs two staff members to operate during the snow season. For planning purposes, each staff member costs on average $110,000 per year to account for salary, benefits, and overtime.

COMMUNITY SUSTAINABILITY ASSESSMENTS AND IMPACTS

- Economic: Safe and efficient travel via local streets, sidewalks, multi-use paths and the transit network affects the overall economic health of Boulder. The Snow and Ice Control Program seeks to limit impacts to the economy due to snowstorm events; however, significant events may result in a reduction of economic activity.

- Environmental: Snow and ice control operations and sidewalk snow removal efforts support multimodal transportation, which benefits air quality. The Snow and Ice Control Program utilizes pre-treatment, anti-icing and de-icing materials that provide a reduced environmental impact when compared to other products. The street sweeping program seeks to remove and safely dispose of residual de-icing material from all snow routes within 72 hours following a storm event when weather allows.

- Social: Snow and ice control operations and sidewalk snow removal efforts support mobility for a diversity of travelers and provides accessibility to employment centers, schools, recreational opportunities and shopping centers.

- Racial Equity: Snow and ice control operations provide access to a plowed street within 2-3 blocks of every residential building throughout the city. Additionally, in neighborhoods where the majority of residents park on-street, we have received mixed feedback about

whether they want their streets plowed. We will continue to assess how best to handle operations on streets where on-street parking is highly utilized acknowledging the need to balance safety and access.

BACKGROUND
The project's purpose is to review the Boulder's Snow and Ice Response program's service, understand the community's preferences and needs, understand industry service levels, and consider changes to the program to better meet goals and expectations.

Boulder's Snow and Ice Response program is a significant investment of city resources. It support's the city's Sustainability, Equity, and Resilience Framework's and the Transportation Master Plan's visions of a safe, accessible, and sustainable multimodal transportation system connecting people with each other and where they want to go.

The program's existing level of service is not clearly defined, resulting in inefficiencies and increased costs to deliver snow services. The community has a range of expectations for snow clearing level of service and an unclear understanding of what services are provided and why.

The project began in Fall 2022 with an expected completion in Winter 2023/2024. Staff will bring recommended changes to a 2025 budget request and an adjustment-to-base request for implementation in the 2024/2025 snow season. The current schedule is as follows:

- Fall 2022: Define the issue and provide contextual background.
- Winter 2022/2023: Seek community feedback on existing program operations.
- Spring-Summer 2023: Evaluate feedback and identify options.
- **Winter 2023/2024: Seek community feedback on options for program changes.**
- Spring 2024: Select and communicate recommended program changes and rationale.

The Snow and Ice Response program focuses on facilities maintained by the Transportation & Mobility Department. Systemwide, the department collaborates with agency partners to clear streets and paths including the Utilities and Parks and Recreations departments, The University of Colorado – Boulder, Boulder County, the Colorado Department of Transportation (CDOT), Regional Transportation District (RTD), Homeowners Associations, and other private entities.

Further information about current program services and delivery is included in **Attachment A**.

ANALYSIS:

How we listened and what we heard:
In Winter 2022/2023, the city sought feedback on current snow and ice clearing service levels. The city offered a virtual on-demand open house and questionnaires (both offered in English and Spanish), an stakeholder meetings with the Community Connectors-in-Residence and agency partners.

The English version of the open house was viewed 3,600 times while Spanish version was viewed 600 times. The English questionnaire, which asked how the community prioritizes components of the program, received over 600 responses. The questionnaire was also offered in Spanish but did not receive any Spanish responses.

People's preferred way to travel (by car, by bike, etc.) often determined their priorities. However, all respondents prioritized snow clearing on major streets and at key crosswalks and pedestrian crossings. All respondents were also mostly satisfied with snow clearing on multi-use paths and mostly dissatisfied with sidewalk snow removal code enforcement.

Specific to travel type, transit users, pedestrians, and drivers prioritized streets with steep grades and tree shade. Bicyclists prioritized on-street bike network and multi-use paths. Drivers prioritized residential streets while transit users and pedestrians prioritized multi-use paths.

Daily drivers were mostly satisfied with snow clearing on major streets while expressing dissatisfaction with minor streets. Daily pedestrians were mostly satisfied with snow clearing on major streets and multi-use paths while being mostly dissatisfied with primary routes and mostly dissatisfied with snow clearing at bus stops and at key crosswalks and pedestrian crossings.

In the free response section, more themes emerged. We heard that the program should increase its focus on equity, environmental impacts, sidewalk snow removal enforcement and communication about snow events and expectations. We also heard that the program should align its priorities with TMP mode share objectives and assess its own performance after snow events.

To deepen our engagement reach, the city met with our Community Connectors-in-Residence as well as agency partners. In these meetings we heard that the city should take a closer look at operations in North Boulder, adjacent to senior housing and within manufactured home communities. We also heard that communications about snow clearing aren't as well known or reaching as deeply in community as needed.

Detailed information on the first round of community engagement is in **Attachment B**.

Program purpose and goals:
Guided by community input, Transportation & Mobility staff revised the snow and ice response program purpose:

> The purpose of the Boulder Transportation & Mobility Department Snow and Ice Response program is to support multimodal travel and accessibility for all people by focusing on equity, safety, mobility and customer service before, during and after snow events.

The Snow and Ice Response Review project has three revised goals that frame the recommendations:

1. To support safe travel for all modes of transportation
2. Provide informative and timely communication to the community
3. Operate the program efficiently, effectively and safely in alignment with the citywide goals

Storm size approach:
The recommended approach to snow clearing response is divided into three categories: small, medium and large snow events.

While the city averages 36 events each year with measurable snow precipitation, most of these events produce a small amount of snow. **Table 1** compares historic snow events in Boulder to the three event categories.

Table 1: Historic snow events by size averaged from 2010 – 2021

Snow event size	Number	Percentage
Small (Trace – 3 inches)	24	67%
Medium (3 – 8 inches)	9	25%
Large (8 or more inches)	3	8%
Annual total snow events	36	

Source: NOAA

Focusing on the amount of snowfall makes communicating the city's snow clearing response more understandable to the public compared to the existing system (primary, secondary and conditional routes).

Environmental considerations:
Rising temperatures will likely lead to an earlier start and later end to future snow seasons due to more moisture in the atmosphere. According to the National Oceanic and Atmospheric Administration, the average first and last day of measurable snow in Boulder is Oct. 16 and April 27 respectively.

Level of service approach:
Streets
The recommended snow clearing level of service for streets is broken into three priority tiers. During any snow event, first priority streets are cleared. For medium snow events, second priority streets are cleared along with first priority streets. Third priority streets are only cleared during large snow events. **Table 2** explains street service expectations.

Table 2: Street level of service by snow event size

Snow event size: % of annual snow events	**Street level of service by priority**		
	First	**Second**	**Third**
Small: 67% (Trace – 3 inches)	Clear by **12** hours after snow stops.		
Medium: 25% (3 – 8 inches)	Pretreated and clear by **12** hours after snow stops.	Clear by **24** hours after snow stops.	
Large: 8% (8 or more inches)	Pretreated and clear by **24** hours after snow stops.	Pretreated and clear by **36** hours after snow stops.	Clear by **48** hours after snow stops.

The project team developed a data-driven approach to prioritize streets for snow removal shown in **Table 3**. The criteria used was influenced by community feedback to align with the mode share objectives in the TMP.

Staff aligned the priority criteria through consideration of transit and bicycle travel. For transit, streets serving high ridership routes, defined as routes serving stops with greater than 50 riders per day, are cleared for any snow amount while all remaining routes are cleared for storms over three inches. For bicycle travel, a combination of the Core Arterial Network (CAN), data from Strava, an online GPS-based platform where people can record and track their bike rides, and Crosstown Bikeways were used.

While many CAN projects have not yet been implemented, snow clearing on CAN street segments needs to be prioritized since these segments provide key connections in the bike network and arterial street designs make clearing snow from bike facilities more challenging due to size of the street and adjacency of high-traffic vehicle lanes.

Within Strava, users can tag their bike rides as a 'commute' for non-leisure trips. Strava bike commuting data was used because a comprehensive citywide bike use dataset does not exist, but still captures segments of the bike network used for non-recreational travel. In future reviews of the program, Strava data can be replaced with city-collected bike volume data.

Crosstown Bikeways is a newly created category of primarily low-stress bikeways that are equitably distributed across the city and provide direct routes to key destinations and continuous connectivity across town. Crosstown Bikeways uses a combination of existing on-street bike facilities and multi-use paths to create a network of principal bike routes.

Table 3: Street priority criteria by mode of transportation

<table>
<tr><th></th><th colspan="3">Streets priority criteria by priority</th></tr>
<tr><th></th><th>First</th><th>Second</th><th>Third</th></tr>
<tr><td rowspan="2">Bicycling</td><td rowspan="2">Core Arterial Network</td><td>More than 700 annual Strava commutes</td><td rowspan="7">Street grades between 4 and 6.5%</td></tr>
<tr><td>On-street segments of Crosstown Bikeways</td></tr>
<tr><td rowspan="2">Transit</td><td>High ridership transit routes</td><td rowspan="2">All remaining transit routes</td></tr>
<tr><td>Bus facility access</td></tr>
<tr><td rowspan="3">Driving</td><td>Average daily traffic more than 14,000</td><td>Heavily used alleys</td></tr>
<tr><td rowspan="2">Critical Emergency Response Routes (highway and arterial)</td><td>All remaining Critical Emergency Response Routes</td></tr>
<tr><td>Street grades steeper than 6.5%</td></tr>
</table>

Applying the proposed priority criteria, the city would clear an additional 4.6 lane miles during large snow events. In total, 65% of all city-owned streets would be cleared. This is a 2% increase over the existing program.

Muli-use paths
Multi-use paths are recommended to be broken into two service priority tiers as shown in **Table 4**.

Table 4: Multi-use path level of service by snow event size

Snow event size: % of annual snow events	Multi-use path level of service by priority	
	First	Second
Small: 67% (Trace – 3 inches)	Clear by **12** hours after snow stops.	Clear by **12** hours after snow stops.
Medium: 25% (3 – 8 inches)	Clear by **12** hours after snow stops.	Clear by **24** hours after snow stops.
Large: 8% (8 or more inches)	Clear by **24** hours after snow stops.	Clear by **48** hours after snow stops.

Similar to street segments, multi-use paths were prioritized in a data-driven approach shown in **Table 5**. The criteria used was influenced by community feedback by aligning with the mode share objectives in the Transportation Master Plan. This was done through the inclusion of the Core Arterial Network (CAN) and Crosstown Bikeways.

Table 5: Multi-use path criteria

	Multi-use path criteria by priority	
	First	Second
Bicycling	Core Arterial Network paths	All remaining paths
	Off-street segments of Crosstown Bikeways	
	Over 3,500 annual Strava commutes	

The city's multi-use path network covers nearly 90 total miles, of which the Transportation & Mobility Department maintains and clears snow from approximately 36 total path miles. The remaining paths are cleared of snow by other departments, government agencies, or private property owners.

If a multi-use path is adjacent to a street (e.g. 28th Street, Arapahoe Avenue), the adjacent property owner is responsible for snow clearing. Under the proposed recommendations for program changes, the T&M Department would continue to clear snow from all paths that it maintains.

Bike network

The city's bike network includes both on-street bike infrastructure and multi-use paths. There are over 175 total lane miles of on-street bike facilities. Of these, the city clears about 79% as a part of current operations. The recommended criteria would close gaps in the bike network, increasing the total on-street bike facilities cleared by the city to 83%. The Transportation & Mobility Department clears snow from all multi-use paths that it maintains. These off-street facilities serve as important low-stress routes within the network.

Designating Crosstown Bikeways allowed staff to identify gaps between on-street bike facilities and multi-use paths in the existing program service and prioritize program changes to provide continuous routes to key destinations and across town that are cleared of snow in storm events.

Protected bike lane and intersection design can vary significantly in materials and location (e.g. street-level or sidewalk-level). As a result, snow and ice response requires tailoring service to each specific facility and deploying specialized plows and contracted shoveling to clear snow. A specialized small plow was recently procured to clear snow from existing protected bike lanes

and intersections. As additional facilities are constructed in the future through the department's capital projects, additional resources and equipment may be needed to maintain a high level of service.

Shoveled areas
Shoveled areas are small or constrained spaces where using larger snow clearing equipment is not feasible. These areas include crosswalks, curb ramps, pedestrian refuges and bus stop platforms. The city hires contractors to remove snow and ice at select locations. The city currently contracts 156 of these locations, 41 of which are transit stops. Additional transit stops are serviced by volunteers through the city's Shovel-a-Stop program. This represents clearing an additional 38 transit stops, bringing the total number of cleared transit stops to 79.

Shoveled areas are proposed to be broken into three service priority tiers shown in **Table 6**.

Table 6: Shoveled areas level of service by snow event size

Snow event size: % of annual snow events	**Shoveled area level of service by priority**		
	First	**Second**	**Third**
Small: 67% (Trace – 3 inches)	Clear by **12** hours after snow stops.		
Medium: 25% (3 – 8 inches)	Clear by **12** hours after snow stops.	Clear by **24** hours after snow stops.	Cleared by Shovel-a-Stop by **24** hours after snow stops
Large: 8% (8+ inches)	Clear by **24** hours after snow stops.	Clear by **24** hours after snow stops.	

Similar to street segments, staff propose to prioritize shoveled areas in a data-driven approach shown in **Table 7**.

Table 7: Shoveled areas criteria by mode of transportation

	Shoveled area criteria by priority		
	First	**Second**	**Third**
Walking and transit	Transit stops with more than 50 riders a day	Transit stops with 35-50 riders a day	Transit stops with less than 35 riders a day
Walking and bicycling	High-use crosswalks, path crossings, and median refuges		
	Crossings on Crosstown Bikeways		

When using the recommended framework, based on 2023 ridership data, 36 transit stops are proposed to be added to the city's clearing responsibilities. It is assumed that transit operators RTD and CU-Boulder will continue to clear snow from the 100 bus stops that they currently maintain. With the recommendations, all stops within ridership of more than 35 riders a day are cleared of snow by a combination of T&M contractors, volunteers, and partner agencies. In total, including the adopted Shovel-a-Stop locations, this represents about 40% of the 556 bus stops in the city, an increase of 8% compared to existing operations.

Eleven low-ridership stops are currently adopted and cleared by volunteers. The recommendations do not change the status of these adopted stops. Clearing the remaining 343

low ridership stops with contractor resources would require a budget request. More information is available in the fiscal impact section of the report.

Level of service summary:
Table 8 summarizes the level of service changes using the recommended snow clearing framework and criteria.

Table 8: Program recommendation comparisons

	Existing system		Recommended		Change
Street lane miles	Primary:	188.4 mi	First:	196.7 mi	4% increase
	Secondary:	213.6 mi	Second:	204.2 mi	5% decrease
	Conditional:	26.8 mi	Third:	32.5 mi	19% increase
	Total:	**428.8 mi**	**Total:**	**433.4 mi**	**1% increase**
On-street bike network	Percentage:	79%	Percentage:	83%	4% increase
Multi-use paths	No change to the amount of multi-use paths serviced (all paths maintained by T&M will continue to be cleared).				
Transit stops	**Total**: 79 41 Contractor 38 Adopted		**Total**: 115 77 Contractor 38 Adopted		**47%** increase in stops cleared by contractors
Crosswalks and median refuges	No change to amount or frequency of crosswalks or median refuges serviced.				

Olsson Associates, the consultant assisting staff, provided a draft graphic to communicate level of service expectations to the public in **Attachment C**.

Racial equity considerations
After the snow clearing criteria were used to determine infrastructure priorities, staff reviewed the recommended services with a focus on racial equity.

The city's existing street clearing was compared to the city's racial equity index. The index ranks Census block groups (from 600 to 3,000 people) on a scale from one to five (low to high racial and ethnic diversity and/or economic stress). The scale from one to five can also be interpreted as areas of lowest to highest priority respectively. **Table 9** compares the existing and recommended level of snow clearing for residential roads compared to the racial equity index.

Table 9: Percentage of residential lane miles cleared compared to the racial equity index

Racial equity indices	Existing	Recommended	Change
5 (highest priority)	29%	36%	7% increase
4	29%	34%	5% increase
3	28%	37%	9% increase
2	34%	38%	4% increase
1 (lowest priority)	39%	36%	3% decrease

The recommended service criteria increase the number of snow-cleared residential streets in most areas of the city. Furthermore, the areas of highest priority receive higher increases in residential street coverage.

Snow clearing operations:
T&M will share any snow and ice program changes with our snow maintenance partners. Changes to snow clearing programs in other departments or agencies are not within the scope of this project. T&M will also share program information and feedback related to sidewalk snow removal code enforcement processes with the Police department. The Code Enforcement Unit may consider updates to Section 8-2-13 of the Boulder Revised Code (BRC) as a separate, future project.

After conducting community engagement and confirming the program's snow clearing criteria, operations staff will review the resulting street and multi-use path network for plow route planning. The review will add streets or paths to existing routes or flag them for future implementation as resources allow.

NEXT STEPS
Staff presented this information to the Transportation Advisory Board (TAB) on Monday, November 13. The board was supportive of staff's recommendation framework and community engagement plan. TAB also shared the following feedback which staff will look further into:

- Consider using additional multimodal data if possible to round out the use of Strava, taking data from services like Lime or BCycle.
- For Strava data, consider including recreational rides in addition to commutes.

Staff will start a second round of community engagement in January and February 2024. Planned engagement includes a second English and Spanish on-demand open house and questionnaire as well as stakeholder meetings. Specifically, staff plans to engage with the Community Connectors-in-Residence, manufactured home communities, Boulder Housing Partners, Community Cycles, Center for People with Disabilities, the National Federation for the Blind, and the Boulder Chamber.

Following engagement in winter 2024, staff will incorporate feedback into the program recommendations. Later in 2024, staff will form a budget request to implement snow and ice program final recommendations for the 2025 snow season.

ATTACHMENTS:
Attachment A – Aug. 8, 2022 TAB memorandum on the Snow and Ice Control program
Attachment B – Snow and Ice Response Review: Round 1 Engagement Summary
Attachment C – DRAFT program service graphic provided by Olsson Associates

CITY OF BOULDER

TRANSPORTATION ADVISORY BOARD
AGENDA ITEM

MEETING DATE: August 8, 2022

AGENDA TITLE: Snow and Ice Control Program Update for the 2022-23 Season

STAFF:

Natalie Stiffler, Interim Director of Transportation and Mobility

Scott Schlecht, Transportation Maintenance Manager

EXECUTIVE SUMMARY

This memorandum provides TAB with an overview of the Transportation & Mobility Snow and Ice Control Program for the 2022-23 season. The city's snow and ice control efforts:

1. Support safe travel for all modes during snow events. Snow and ice control is an important element in the city's focus on travel safety and Vision Zero goals to reduce serious injury and fatal crashes.
2. Focus on efficiency, effectiveness, and safety, in alignment with Transportation Master Plan, Boulder Police Department Master Plan and Boulder Fire Department Master Plan goals.
3. Provide informative and timely communication to community members.

This memo summarizes key program goals, provides an overview of 2021-22 operations, a summary of lessons learned for future planning, an introduction to program update efforts, and expectations for the 2022-23 season.

FISCAL IMPACT

The Snow and Ice Control Program is managed by the Transportation & Mobility Department, with an adopted 2021 budget of $1.72 million. The annual budget is developed each year for predicted average weather patterns and events. One or more significant snowfall events, or extenuating circumstances, can increase costs more than those allocations. If additional funding is required, reserves can be allocated through the city's supplemental appropriations process. In addition to the Transportation budget, the

Boulder Police Department accounts for costs involving sidewalk snow removal enforcement.

COMMUNITY SUSTAINABILITY ASSESSMENTS AND IMPACTS

- Economic: Safe and efficient travel via local streets, sidewalks, multi-use paths and the transit network affects the overall economic health of Boulder. The Snow and Ice Control Program seeks to limit impacts to the economy due to snowstorm events; however, significant events may result in a reduction of economic activity.
- Environmental: Snow and ice control operations and sidewalk snow removal efforts support multimodal transportation, which benefits air quality. The Snow and Ice Control Program utilizes pre-treatment, anti-icing and de-icing materials that provide a reduced environmental impact when compared to other products. The street sweeping program seeks to remove and safely dispose of residual de-icing material from all snow routes within 72 hours following a storm event when weather allows.
- Social: Snow and ice control operations and sidewalk snow removal efforts support mobility for a diversity of travelers and provides accessibility to employment centers, schools, recreational opportunities and shopping centers.
- Racial Equity: Snow and ice control operations provides access to a plowed street within 2-3 blocks of every residential building throughout the city. Additionally, in neighborhoods where the majority of residents park on-street, we have received mixed feedback about whether they want their streets plowed. We will continue to assess how best to handle operations on streets where on-street parking is highly utilized acknowledging the need to balance safety and access.

BACKGROUND

During snow events, 17 Transportation and Utilities owned plow trucks operate on Boulder streets. Four pairs of trucks plow four primary routes, and nine plow trucks operate on the other nine routes (8 secondary routes and one additional primary route). Primary and secondary plow routes cover approximately 330 lane miles (52.6%). An additional two smaller trucks and a Utility vehicle address the multi-use paths. All snowplows are equipped with Automatic Vehicle Locator (AVL) technology to provide tracking of vehicle locations and material usage.

As current practice and over the past several years, when the forecast calls for more than eight inches of snow or three days of temperatures below freezing, some additional residential streets are plowed as “conditional routes” subject to available staffing and other resources.

Approximately 164 lane miles (83%) of on-street bike lanes and designated on-street bike routes, and approximately 72 miles (100%) of hard-surface multi-use paths are plowed by Transportation and Mobility and partners including Utilities, Parks and Recreation, University of Colorado- Boulder, Boulder County, Home Owners Associations, and

other private entities. The city also has contracts for hand removal of snow and ice that include 204 locations for crosswalks and curb ramps and 39 bus stops. These locations are prioritized based on travel volumes and characteristics of adjacent paths.

More information about current routes may be viewed online at https://bouldercolorado.gov/services/snow-and-ice-removal.

Anti-icing and De-icing materials

The Snow and Ice Removal teams use existing and predicted weather conditions to determine what type of materials should be used and in what locations. For example, staff may pretreat streets before snowfall. This begins with a liquid anti-icing material, which can help reduce the buildup of snow and ice. However, this application is not done if the snowfall is preceded by rain which will dilute the anti-icing materials. In some less severe storms, staff may only pretreat a subset of streets that tend to have more challenging conditions due to factors such as slope and shading.

Materials are used to minimize water quality impacts. Materials used include a liquid magnesium chloride solution, Meltdown Apex, which is costlier but less corrosive than traditional formulations of magnesium chloride; a granular material called Ice-Slicer RS, composed of complex chlorides that dissolve over time; and liquid salt brine.

Salt brine is a liquid solution containing water and salt (sodium chloride) that aides in reducing the adhesion of snow and ice on road/path surfaces. This is not intended to replace some of our other options, as each material has limits on effectiveness based upon storm conditions. We continue to experience the following benefits of using salt brine:

- Expansion of pre-treatment practices, allowing for increased time between the start of a storm and the accumulation of snow and ice accumulation on surfaces.
- Reduced water quality impacts, due to the dilution rate of the salt.
- Reduction in operational costs based upon lower quantities used resulting in lower material costs.

Staff continue to consult with many other Front Range communities to understand their practices and the benefits that they identify in using salt brine. Other agencies using this include Fort Collins, Longmont, Denver, Loveland and the Colorado Department of Transportation.

Residents will continue to see pre-treatment activities occur prior to storm events. Trucks will apply the materials prior to storm events to allow for the chlorides to bond to the road and path surfaces. Residents may also see stripes that appear along these areas as the materials dry.

Based on TAB feedback from last year, we did apply pre-treatment to a section of street that does not receive plowing service. We did not experience an appreciable difference in melting, likely due to the material diluting and snowfall continuing well after material effectiveness was diminished.

Sweeping

Street sweepers travel all snow routes to remove remaining residual de-icing material within 4 days following a storm event as weather allows. Removal of this material, which may otherwise wash into storm drains and/or volatilize into the air, is critical to meet stormwater and air quality regulations. Once again, we met our Agency PM-10 Emissions Reduction level, but fell 5% short of our Denver Regional Council of Governments 2015 commitment of 70% reduction.

Sidewalk snow removal

City contractors hand-clear certain areas of the Transportation and Mobility–maintained rights of way, including frequently used crosswalks, curb ramps, and bus stops. Additionally, private contractors are responsible for snow removal through or around construction zones during snow events. Transportation and Mobility and other city departments clear sidewalks adjacent to city-owned properties. Transportation and Mobility coordinates with other partners responsible for clearing snow in certain areas of Boulder, including the University of Colorado (CU) and the Regional Transportation District (RTD).

Section 8-2-3, B.R.C., 1981 requires that sidewalks adjacent to both residential and commercial properties be cleared of snow and ice no later than 24 hours after snowfall stops. Property owners, tenants and property managers can each be held responsible for failure to remove snow. Violation of the ordinance can result in a municipal court summons and fine ($100 for first offense) or abatement, in which the city hires a contractor to clear the sidewalk at the property owner's expense. Enforcement of the sidewalk snow removal ordinance is handled by the Code Enforcement Unit in the Boulder Police Department.

The National Weather Service website (http://w1.weather.gov/data/obhistory/KBDU.html) is the official resource for local weather conditions. The information is updated every 20 minutes. To learn when the "24 hours after snowfall stops" time period begins, community members can go to the website and look for the "Weather" column (with descriptions ranging from "Fair" to "Snow", etc.) and corresponding time, check the "Snow and Ice" page on the city's website or call the code enforcement line at 303-441-1875.

Code Enforcement may begin enforcing the snow removal ordinance 24 hours after the last mention of snow listed on the National Weather Service website. During consecutive storms, the original stop of snowfall will be enforced if no apparent effort is made to keep the sidewalks cleared for safe passage.

Additional code enforcement information can be found on www.inquireboulder.com under "Police Code Enforcement Unit," which includes a link to the National Weather Service report for Boulder.

Communications

The communication team works to ensure access to current information regarding snow and ice safety and operations. This includes proactive notification to residents, property owners, businesses, commuters and visitors regarding weather forecasts, what the city is doing to prepare and respond to the event and what people can do to stay safe during the event. Communication staff uses channels including the Snow and Ice Control Program website, social media, the community newsletter, Inside Boulder News, press releases and a utility bill insert.

ANALYSIS

Our most recent, formal community engagement effort was a 2018 Community Survey. We asked Boulder residents to evaluate city livability with respect to a variety of services. Responses were then compared to a national benchmark of responses to such questions. Of the respondents, 58%rated snow removal positively, compared to 54% in 2016. While this response remained similar to the national benchmark, it did indicate room for improvement. We understand that this information is outdated and are working to engage the community for updated feedback over the next year.

Informed by this and other feedback and building on lessons learned during previous snow seasons, three overarching goals were identified in 2017 to continue to evolve the Snow and Ice Control Program. Those goals were: 1) Support safe travel for all modes during snow events; 2) Operate the program efficiently, effectively, and safely in alignment with the Transportation Master Plan and Boulder Police Department goals; 3) Provide informative and timely communication. Staff will continue to work toward these goals. The table below summarizes operational approaches to achieve each of the three program goals.

Goal	How we operationalize goals
1. Support safe travel for all modes during snow events.	Snow removal is prioritized as follows: a. Clear primary routes connecting hospitals and urgent care facilities and supporting first responders; as well as primary off-street multi-use paths and critical on-street connections. b. Clear secondary routes allowing provision of essential services throughout the city, including access to schools and multimodal facilities (e.g., frequently used bike routes and designated bus stops) and residential areas with significant shade and steep slopes. c. As conditions warrant, clear additional designated conditional residential routes.
2. Operate the program efficiently, effectively and safely, in alignment with Transportation Master Plan goals.	a. Continue to make improvements to the training program and evaluate performance. b. Use equipment best suited to needs, and maintain equipment to facilitate safety and efficiency. c. Consider environmental impacts in selecting de-icing materials and in post-storm materials sweeping. d. Analyze data and review factors affecting operations such as route criticality, service levels, materials usage, route coverage and plowing practices, and evaluate and support implementation of any needed changes in practices and/or routes. e. Support enforcement of sidewalk snow removal regulations. (Section 8-2-13, B.R.C. 1981).
3. Provide informative and timely communication.	a. Promote a shared (internal and external) understanding of service levels. b. Provide timely updates to the community before, during and after a snow event.

During the 2021-22 snow season:

- Very little accumulating snow prior to January 1, just one day after catastrophic winds and wildfire.
- Less snow than previous season, although the same number of snow events and above seasonal average snowfall.
- Implemented an early pre-season communication push to help prepare the community and set expectations for the upcoming winter season.
- Implemented the Shovel-a-Stop volunteer program to help keep bus stops accessible when it snows.
- Approximately $1.2 million was spent on snow and ice control for Transportation and Mobility for 2021-22. This includes snow removal on roadways and most multimodal paths. This was slightly less than 2020-21 season.
- De-icer vendor was unable to provide granular material between February and March due to supply shipping issues.

- The snowfall amount was 87.3" during the 2021-2022 season.
- During 17 storm events, approximately 74 response shifts were called.
- We received about 16" less snowfall compared to 2020-21 with the same number of events, although we had 7 more responses. Most of the early season shifts were called based on forecasts that did not bring accumulating snow. Once snow began, we spent several extra shifts responding to numerous off-route residential requests.
- About 1,019 tons of granular ice slicer (nearly 55% reduction), 6,198 gallons of magnesium chloride (69% reduction), and 150,489 gallons of Salt Brine were used (nearly 12% increase).
- About 50 percent of 328 lane miles were swept following storms (within 72 hours following a storm's end).
- Department staff fielded 304 inquiries for snow removal assistance requests/complaints between January 1 and March 22. Location analysis is still underway.

Lessons Learned

- In 2017-18, snow removal practices were changed along four of the primary routes. In past years, the practice of windrowing (moving snow to the center of the street in order to minimize impacts to the outside shoulders and bike lanes) required staff to move the snow multiple times to minimize melting and freezing of the windrows into the roadway. In addition to the cost inefficiencies of this practice, it also created a safety hazard for turning vehicles, including emergency responders. Eliminating windrowing improved the efficient use of resources, reduced overall costs, and minimized hazards to turning and crossing traffic. For rare, very large snow events, staff may utilize this method when there is a lack of snow storage. Further refinement of snow placement on secondary and conditional routes also occurred and minor changes along these routes will continue to be implemented and tested.
- In Fall/Winter 2019, staff provided an update to city council on existing level of service costs and proposals for expansion of the snow and ice control program to become more resilient to the possibilities of more frequent intense storms. Some of the areas included:
    - Additional equipment costs to increase efficiency on existing plow routes.
    - Temporary snow storage alternatives.
    - Expansion of contracted service areas such as hand shoveling locations including additional bus stops; curb ramps and crossings.
    - Route expansion, including more residential roads or heavier frequency along off-street transportation corridors.

  Each of these expansion areas were initially explored pre-COVID-19 budget impacts. Staff will continue to assess needs, explore areas for enhancement, and look for additional funding as organizational resources allow.
- Throughout 2021-22, due to COVID-19 public health guidance, the city crews continued to operate staggered shifts. Due to the nature of staggered shifts, this

caused reduced plow time and presented communication barriers between shifts. Given the uncertainty of COVID-19 public health impacts, it is unclear whether these procedures may continue into the next season.

- Staff will continue to focus on increased proactive communication with the community. Staff will keep the program webpage updated to enhance communication and utilize a variety of media outlets to communicate service plans.
- City departments will continue to promote volunteer programs to improve access and mobility along multimodal transportation corridors as well as to provide options for community members who may not be able to easily address their snow removal responsibilities.
- The sweeping program and metrics improved from previous years will continue to be analyzed to increase frequencies as staffing and funding allow to support compliance with air quality regulations.
- Customer inquiries, requests and feedback are categorized and mapped to identify trends. Based on this data, some minor adjustments may be implemented and monitored to evaluate effectiveness of operations. These adjustments include snow placement, route adjustment, and resource deployment.
- Salt brine will continue to be used. We will continue to monitor and test out pretreatment opportunities throughout the system.
- Staffing levels create coverage challenges with little resiliency for unforeseen circumstances.
- Utilities Maintenance staff continues to provide staffing for more than half of our plow routes.
- Comprehensive training is paramount to staff and public safety and effectiveness of the program.
- Vehicle care and maintenance are important to the success of the program. We have experienced significant delays on vehicle repairs from delayed parts deliveries and availability.

NEXT STEPS

The city's official "snow season" begins early-September, based on the possibility that snow may fall that early in the year. Staff will be engaged in training and final preparation this fall and respond to snow events as described above.

Current staffing levels are sufficient for covering all designated routes. During times of unforeseen circumstances, such as employee or family illness or other leave, staffing may become insufficient for full coverage. Reduced coverage plans are currently being developed to address these instances. Due to significant attrition rates over the past few years, we will be implementing a more comprehensive training program. This will reduce coverage during the first several snowstorms as newer staff are paired with veteran drivers to become familiar with operations during active snow events. Real life snow training will significantly reduce the likelihood of improper plowing methods and damage to city and private property.

Finally, staff is in the early stages of a multi-year snow and ice program analysis and update project. During this project staff will assess the current snow and ice program, explore service level impacts to the city's Sustainability, Resilience, and Equity Framework, identify ongoing metrics, and community needs and expectations. Staff will seek community, advisory boards, and City Council's feedback to develop and implement service level options. Implementation will begin to take place during training for the 2023-24 snow season and will continue to be assessed. Some minor changes may begin during the 2022-23 season as identified through this project, as feasible. Staff will return to TAB in late 2022 or early 2023 with more detail on this project.

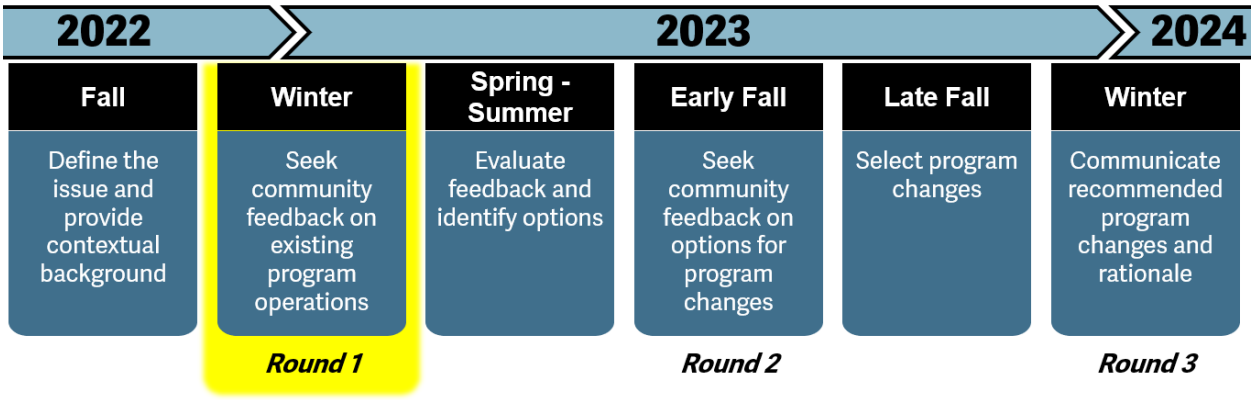
Snow and Ice Response Review: Round 1 Engagement Summary

Engagement Overview

The project's goal is to ensure the Transportation and Mobility Department's Snow and Ice Response Program delivers a high standard of safety, mobility and customer service to provide safe travel for the entire community. The first round of engagement focused on connecting with the community citywide to increase awareness of where snow and ice response services are delivered and why, and solicit input to inform potential changes to the program. A virtual on-demand open house and corresponding online questionnaire were the primary engagement tools used with the community. The project team also conducted stakeholder meetings with the Community Connectors-in-Residence, other city departments and transit operators.

Engagement Timeline

Engagement with the public will focus on three main touch points – Winter 2023, Early Fall 2023 and Winter 2024. This summary corresponds with the first round of engagement.



Audiences – Who did we try to reach?

Our goal in the engagement plan was to reach a citywide audience. The community members we tried to reach and the methods we used are summarized in the table below.

Audiences	Communication methods
Individuals who live or work in Boulder	Citywide bilingual mailer to every residential and commercial address; social media posts; project website and FAQ; city newsletters; Inside Boulder news
Stakeholders and Partners	Direct communications; focused meetings
TAB	March 13, 2023 meeting presentation and discussion
City Council	Heads Up Email sent in February

Additionally, our online questionnaire reached the following audiences.

- 3,600/180 English/Spanish views
- 618 English responses

- By way of travel:
    - 378 responses identified as daily pedestrians
    - 355 responses identified as daily drivers
    - 125 responses identified as daily bicyclists
    - 27 responses identified as daily transit users

Approach to Diversity, Equity & Inclusion Audience

The engagement plan was informed by a number of strategies identified in the project's Racial Equity Instrument. These included:

- Translating all materials to Spanish, including the questionnaire
- Creating a communications plan that leveraged partnerships to spread the word about the on-demand open house and questionnaire
- Gathering demographic data in the online questionnaire to assess if we reached the intended racial, age, neighborhood diversity and income
- Meeting directly with the Community Connectors-in-Residence

Boulder Engagement Strategic Framework Audience

The Boulder City Council adopted the Engagement Strategic Framework in 2017 that utilizes the International Association for Public Participation (IAP2) engagement spectrum to design engagement plans. This round of engagement fell within the "Inform" and "Consult" levels:

INCREASING IMPACT ON THE DECISION

	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
PROMISE TO THE PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

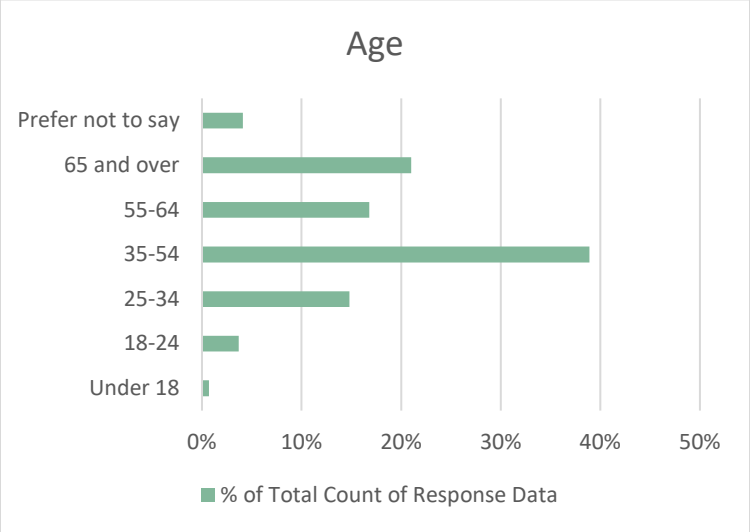
Virtual On-Demand Open House

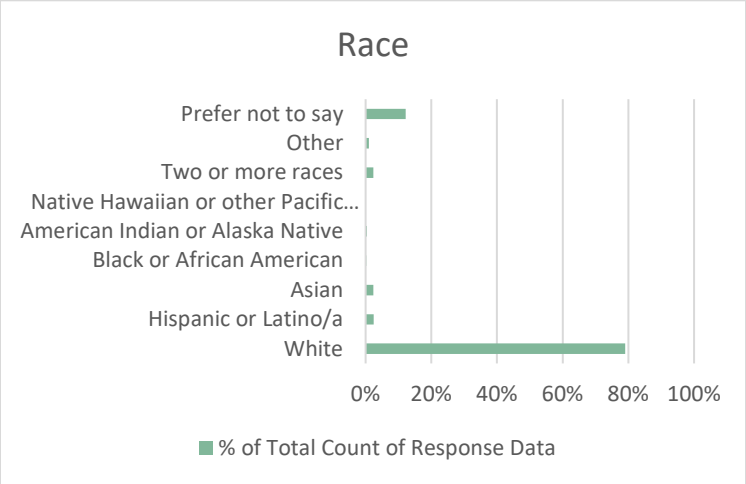
The ESRI StoryMap platform was utilized to host the virtual on-demand open house due to its capability of displaying interactive maps of snow and ice response operations. English and Spanish versions of the StoryMap were published.

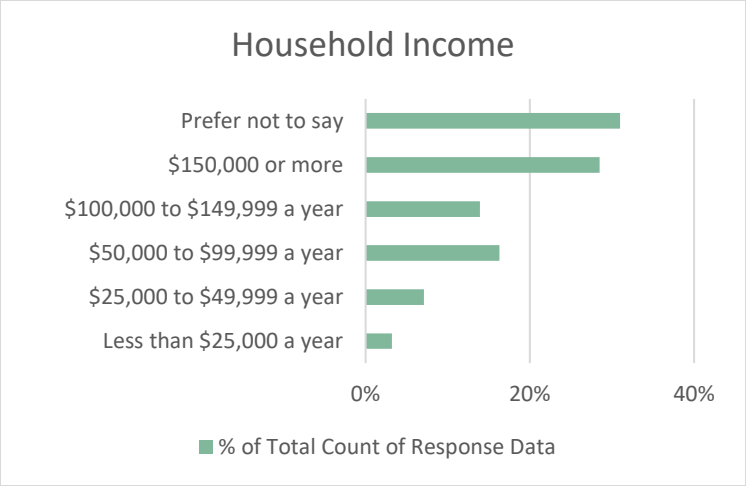
Questionnaire Results

Demographics Overview

The graphs below represent the demographic characteristics of the 618 questionnaire respondents, including those that chose not to respond to some or all demographic questions.







Analysis

Prioritization

We asked how the community would prioritize the existing eight components of the Snow and Ice Program.

1. Snow clearing on major streets
2. Snow clearing on streets with steep grades and tree shade
3. Snow clearing on residential streets
4. Snow clearing on multi-use path network
5. Snow clearing on-street bike network
6. Shoveling at key crosswalks and pedestrian crossings
7. Shoveling at bus stops
8. Sidewalk snow removal code enforcement[1]

Responses differed by mode type, but all respondents prioritized snow clearing on major streets and at key crosswalks and pedestrian crossings. Bicyclists prioritized multi-use paths and on-street bike networks. Transit users and pedestrians prioritized streets with steep grades and tree shade and multi-use paths. Drivers prioritized streets with steep grades and tree shade and residential streets.

Satisfaction Levels

All Modes

We also asked the community about their satisfaction with each of the Snow and Ice Program components. Similar to the prioritization question, responses differed by mode. All modes, however, were mostly satisfied with snow clearing on multi-use paths and mostly dissatisfied with sidewalk snow removal code enforcement.

Daily Drivers

[1] Sidewalk snow removal is the responsibility of the adjacent property owner as per Section 8-2-13 of the Boulder Revised Code (BRC).

Drivers varied in their satisfaction levels for primary routes. About half of participants were satisfied with snow clearing on primary routes and the other half were dissatisfied. Drivers also expressed dissatisfaction with secondary and conditional routes.

Daily Pedestrians

Pedestrians were mostly satisfied with snow clearing on primary routes and multi-use paths. They were mostly dissatisfied with conditional routes and shoveling at bus stops.

Daily Bicyclists

Bicyclists were mostly satisfied with primary routes and multi-use paths. They were mostly dissatisfied with the on-street bike network and key crosswalks and pedestrian crossings.

Daily Transit Riders

Transit users were mostly satisfied with primary routes and mostly dissatisfied with snow clearing at bus stops and at key crosswalks and pedestrian crossings.

Free Response Summary

Survey respondents had the opportunity to provide additional thoughts through three free-response questions. Several themes emerged from these responses.

The Snow and Ice Response Program should:

- Increase its focus on equity
- Assess its performance after snow events
- Align its priorities with the mode share objectives in the Transportation Master Plan
- Increase its focus on lessening environmental impacts
- Clarify and communicate expectations to the public around snow and ice response
- Increase sidewalk snow removal code enforcement
- Improve communication about snow events and the Snow and Ice Response Program
- Address specific locations that community members highlighted as problem areas during snow events

Stakeholder Meetings

The project team met with key stakeholders and partners during the first round of engagement. Key takeaways from the *Community-Connectors-in-Residence* are summarized below:

- Some connectors were not aware of communication notices, or that service requests can be made via the snow dispatch line. Others shared that the methods of communication may not actually be well known and therefore people who need services the most are not informed and need to be.
- The department should focus or prioritize clearing snow from public streets within manufactured home communities
- North Boulder is an area that does not seem to be a priority for snow clearing based on experiences shared
- It is challenging for people with disabilities to access bus stops since they are often not shoveled
- The program should analyze program operations adjacent to senior housing

Gaps in Engagement Feedback

While the project team attempted to reach a variety of community members, particularly underrepresented groups, we think there are still some gaps in representation from the feedback[2]. Most notable, the Spanish version of the questionnaire did not receive any responses. Takeaways from the optional demographic questions in the questionnaire are summarized below. The project team will work on strategies to reach underrepresented demographic groups, including non-English speakers, during future rounds of engagement.

Race: Gap in all races other than White compared to the 2020 Census data for the City of Boulder

	Online Questionnaire	2020 U.S. Census Data
White	79.0%	76.4%
Hispanic or Latino/a	2.5%	13.2%
Asian	2.4%	8.0%
Black or African American	0.2%	1.5%
American Indian or Alaska Native	0.4%	0.5%
Native Hawaiian or other Pacific Islander	0.0%	0.1%
Two or more races	2.4%	5.5%
Other	1.0%	0.7%
Prefer not to say	12.2%	N/A

Income: Gap in representation for low-income participants earning less than $50,000

	Online Questionnaire	2020 U.S. Census Data
Less than $25,000 a year	3.2%	21.5%
$25,000 to $49,999 a year	7.1%	13.8%
$50,000 to $99,999 a year	16.3%	21.6%
$100,000 to $149,999 a year	13.9%	15.0%
$150,000 or more	28.5%	28.1%
Prefer not to say	31.0%	N/A

[2] It's possible that the online questionnaire respondents who skipped demographic question(s) or selected "I prefer not to say" may skew these results.

Snow Total

	0 to 3 inches (up to the height of a credit card)			3 to 8 inches (the height of a credit card to about the height of a water bottle)			8+inches (about the height of a water bottle and higher)		
	Before Storm	During Storm	After Storm	Before Storm	During Storm	After Storm	Before Storm	During Storm	After Storm
1st Priority Streets			Clear by **12** hours after snow stops			Clear by **12** hours after snow stops			Clear by **24** hours after snow stops
2nd Priority Streets						Clear by **24** hours after snow stops			Clear by **36** hours after snow stops
3rd Priority Streets									Clear by **48** hours after snow stops
Off-Street Paths			Clear by **12** hours after snow stops			Clear by **24** hours after snow stops			Clear by **48** hours after snow stops
Shoveled Areas*			Clear by **12** hours after snow stops			Clear by **24** hours after snow stops			Clear by **24** hours after snow stops

*Sidewalks adjacent to both residential and commercial properties are to be cleared of snow and ice no later than 24 hours after snowfall stops, per Boulder Revised Code, Section 8-2-13.