Southeastern Wisconsin

Regional Planning Commission

Chloride Impact Study for the Southeastern Wisconsin Region

TAC Meeting
April 8, 2026

#279804

Speakers

- Laura Herrick, Chief Environmental Engineer
- Aaron Owens, Principal Planner
- James Mahoney, Engineer

Agenda

- Review of Summary Notes from February 25, 2026, TAC meeting
- Review of preliminary draft chapter of SEWRPC Technical Report No. 66, *State of the Art for Chloride Management*
  - *Chapter 2 – Winter Maintenance Practices*
- Next Steps

Chloride Study Reports

- *PR-57 A Chloride Impact Study for Southeastern Wisconsin*
- *TR-61 Field Monitoring and Data Collection for the Chloride Impact Study*
- *TR-62 Impacts of Chloride on the Natural and Built Environment*
- *TR-63 Chloride Conditions and Trends in Southeastern Wisconsin*
- *TR-64 Regression Analysis of Specific Conductance and Chloride Concentrations*
- *TR-65 Mass Balance Analysis for Chloride in Southeastern Wisconsin*
- ***TR-66 State of the Art for Chloride Management***
- *TR-67 Legal and Policy Considerations for the Management of Chloride*

Review of Summary Notes from February 25, 2025, Technical Advisory Committee Meeting

Technical Report No. 66
State of the Art in Chloride Management

Chapter 2 – Winter Maintenance Practices

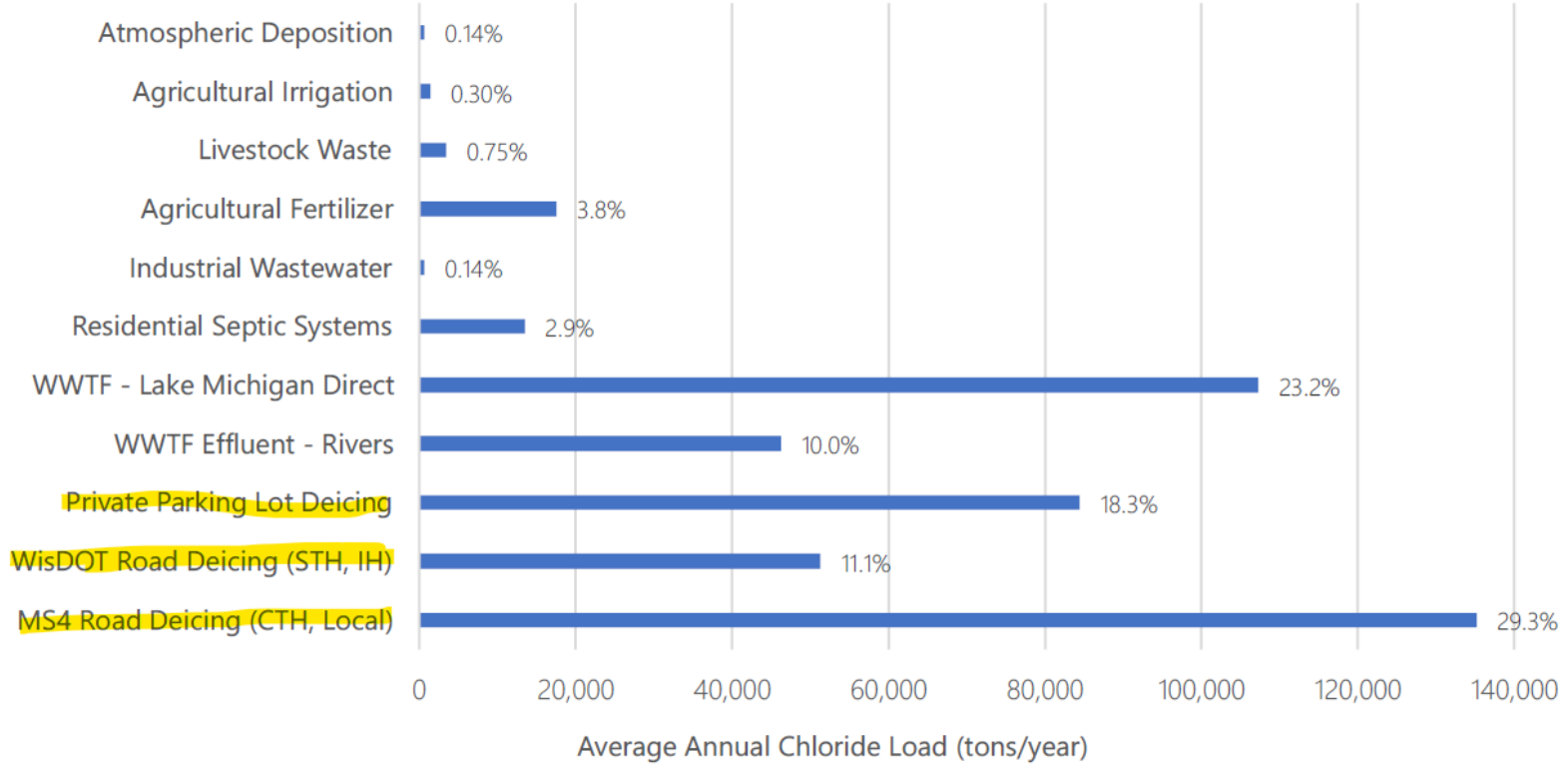
Photo Credit: Wikimedia User Emma0mb

Chapter 2 – Winter Maintenance Practices

- Chapter 2 Overview
  - 2.1 Introduction
  - 2.2 Public Winter Maintenance Policies and Practices
  - 2.3 Private Winter Maintenance Practices
  - 2.4 Low Salt Infrastructure Design
  - 2.5 Chapter Summary

Sources of Chloride in the Region (TR-65)

Figure 4.1
Regional Chloride Budget: Average Annual Chloride Source Loads for Southeastern Wisconsin



Note: Average annual chloride source loads were computed for the study period as described in Chapter 3.

Source: SEWRPC

Public Winter Maintenance Policy & Practices (State, County, and Municipal)

Policies and Public Expectations

- "Bare Pavement" policy → "Passable Roadways" standard

- Tiered Level of Service
  - Concentrating initial efforts on arterials, transit and emergency routes
  - Residential streets may take 18-24 hours to clear

- Public Education and Expectation Management
  - Educate public on practice and strategy changes
  - Educate on true environmental and economic costs of bare pavement policies
  - Adjust driving behavior – match driving speed to road conditions
  - Discourage non-essential travel!

Winter Maintenance Planning

Well-Defined Policy Document

- Provides staff with guidelines to meet specific objectives
- Inform the public of the procedures
- Defines level of service
- Ensures operational consistency

Specialized Salt Management Plan

- Act as technical roadmaps
  - Application rate charts
  - Calibration Schedules
  - Protection for salt-sensitive areas

Personnel Training

- Success of Modern Chloride Management Strategies Relies on Buy-In from Administration, Managers, and Operators
- Comprehensive Training Programs Prove Effectiveness and Ensure Personnel are Skilled in Implementing New Strategies
- Key Training Components:
  - Monitoring pavement temperatures
  - Understanding treatment options and which materials are best for specific conditions
  - Equipment calibration
- Wisconsin Salt Wise
- Minnesota Pollution Control Agency “Smart Salting” Program
- American Public Works Association

Winter Maintenance Operations

Mechanical Snow & Ice Removal

- Primary Tool and Most Cost Effective and Environmentally Sustainable Method
  - Plowing Has a High Benefit-Cost Ratio
- Maximizing mechanical removal allows agencies to significantly reduce necessary chemical applications
- High Frequency Passes Prevent Snow from Compacting into Hardpack by Vehicles
- Timing and Plowing Efficiency
- Tandem Plowing

Figure·2.1¶
Tandem·Plowing·in·the·City·of·Oak·Creek,·WI¶

Source:·City·of·Oak·Creek·Public·Works·Department¶

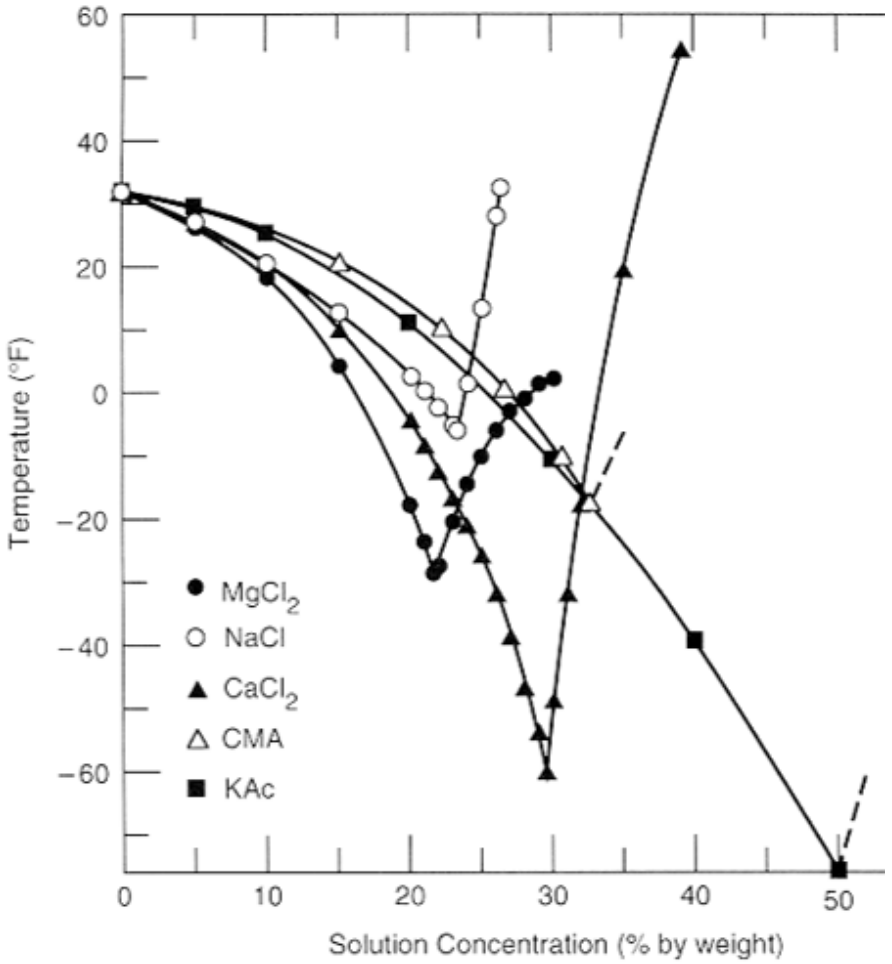
Snow and Ice Control Materials

Snow and Ice Control Materials

Principles of Chemical Melting

- Most deicing chemicals do not melt ice through heat generation but through freezing point depression.
- When the solute dissolves in water, it interferes with the ability of the water molecules to bond into ridged ice crystals
- Theoretical limits of deicing chemical are shown in its phase diagram

Figure-2.2¶
Phase-Diagrams-for-Chloride-and-Acetate-Deicers¶



Practical Working Temperatures

- Eutectic Limit (theoretical) is typically much different than a materials "practical working temperature" (performance in the field)

- Two factors prevent a chemical agent from reaching its theoretical limit in the field:
  - As ice melts on the road, water is added to the solution, constantly diluting the chemical concentration and raising the freezing point.
  - While chemical may theoretically work at its eutectic limit, the reaction often happens too slowly to be useful.

- Therefore, agencies use "practical working temperatures" to provide a necessary safety margin against refreezing and to ensure melting occurs within a reasonable timeframe
- See **Table 2.1** for lowest practical working temperatures and other characteristics of the most common winter maintenance materials.

Chloride-Based Material

Sodium Chloride (Rock Salt)

- Only when rock salt has dissolved into a brine can it begin to melt snow/ice
- Best used on roadways with moderate to high volumes where pavement temperatures are above 15°F
- Most effective when pre-wetted with a liquid to reduce significant bounce and scatter
- Poor performance in cold temperatures and on low-volume rural roads
- Highly corrosive to steel and concrete
- Toxic to aquatic life, degrades soil quality, harmful to roadside vegetation

Sodium Chloride Liquid Brine (NaCl)

- Rock salt dissolved in water at a 23.3% concentration
- Primary tool for anti-icing applications
- Prevents the snow-pavement bond from forming, making plowing much easier
- Often used as a pre-wetting liquid for rock salt
- Can be used for Direct Liquid Application (DLA)
- Generally limited to pavement temperatures above 15°F
- Can be diluted quickly by heavy snowfall or rain
- Storage can be a challenge

Magnesium Chloride ($MgCl_2$)

- Practical working temperature to -10°F
- Exothermic (releases heat as it dissolves and hygroscopic (attracts moisture from air)
- Typically purchased and stored in liquid brine form
- Ideal for pre-wetting rock salt in colder temperatures
- More expensive than rock salt
- Less corrosive to steel than rock salt, but more damaging to concrete
- Toxic to aquatic life, degrades soil quality, harmful to roadside vegetation
- Because it can draw moisture from air, can potentially lead to slick conditions

Calcium Chloride ($CaCl_2$)

- Exothermic (releases heat as it dissolves and hygroscopic (attracts moisture from air)
- Typically purchased and stored in liquid brine form
- Practical working temperature down to -20°F
- Ideal for emergency deicing in deep freeze conditions
- Most expensive form of chloride salts
- Highly corrosive to steel and concrete (more than rock salt)
- Toxic to aquatic life, degrades soil quality, harmful to roadside vegetation
- Because it can draw moisture from air, can potentially lead to slick conditions

Acetates – Non-Chloride Alternatives

- Most commonly used non-chloride materials
  - Calcium Magnesium Acetate (CMA), Potassium Acetate (KAc), Sodium Acetate (NaAc)
- Most effective when used as an anti-icing agent
- Biodegradable and non-corrosive to structural steel
- Cost-prohibitive for general municipal road maintenance
- "High-performance" alternative - used in specialized situations (parking structures, bridge decks, environmentally sensitive areas/no-salt zones, airports)
- Can moderately increase biochemical oxygen demand in surface waters during decomposition causing temporary oxygen depletion

Formates – Non-Chloride Alternatives

- Newer to winter maintenance world; Similar performance to acetates
  - Potassium Formate – Aggressive low-temp liquid agent (-20°F)
  - Sodium Formate – Low-temp (0°F), fast acting granule or powder
- Biodegradable and non-corrosive to structural steel
  - Can have negative impacts on concrete, asphalt, and galvanized steel but less than rock salt
- Cost-prohibitive for general municipal road maintenance (15-20x rock salt)
- Used in specialized situations (bridge decks, environmentally sensitive areas/no-salt zones, airports)
- Can moderately increase biochemical oxygen demand in surface waters during decomposition causing temporary oxygen depletion

Bio-Based Additives

- Typically derived from agricultural or industrial processing
  - Beet Juice Blends
  - Corn-Based Additives
  - Cheese Brine
- Blended into salt brine or other liquid chlorides to enhance performance – typically for anti-icing applications
- Introduction of carbohydrates and sugars interferes with ice crystal formation, provides corrosion inhibition, and adds viscosity
  - Can reduce corrosive impact on infrastructure and fleet equipment by up to 70%
- Can suppress freezing point of salt brine, potentially lowering practical working temperature down to 0°F
- Increase biological oxygen demand in local waterways, decreasing dissolved oxygen levels

Winter Maintenance Material Blends

Liquid Brine Blends

- The Hot Mix
  - Combines sodium chloride brine with magnesium chloride or calcium chloride to extend performance in colder conditions
  - Improves melting speed
  - Typical ratios: 90/10 brine to $MgCl_2$ or $CaCl_2$ for moderate cold and 80/20 for extreme cold

- Organic-Enhanced Brine
  - Adds bio-based additives to increase viscosity and provide corrosion protection
  - Helps liquid adhere to pavement, resist wind/traffic displacement
  - Interferes with the formation of ice crystals, preventing hard snow/pavement bond

- Triple Blends/Super Mixes
  - Combine salt brine, a hot chloride ($MgCl_2$ or $CaCl_2$), and bio-based additive

Chemical Treatment of Winter Roads

Anti-Icing/Pre-Treatment

Cheaper and More Efficient to Prevent Ice Bond than to Melt Ice

- **Proactive Strategy**: Applying a freezing point depressant (typically salt brine) to dry pavement *BEFORE* a forecasted snow event to prevent a strong bond between frozen precipitation and road surface

- **Saves Energy:** Removing snow after a bond is formed requires 10 times more energy than preventing its initial formation with anti-icing

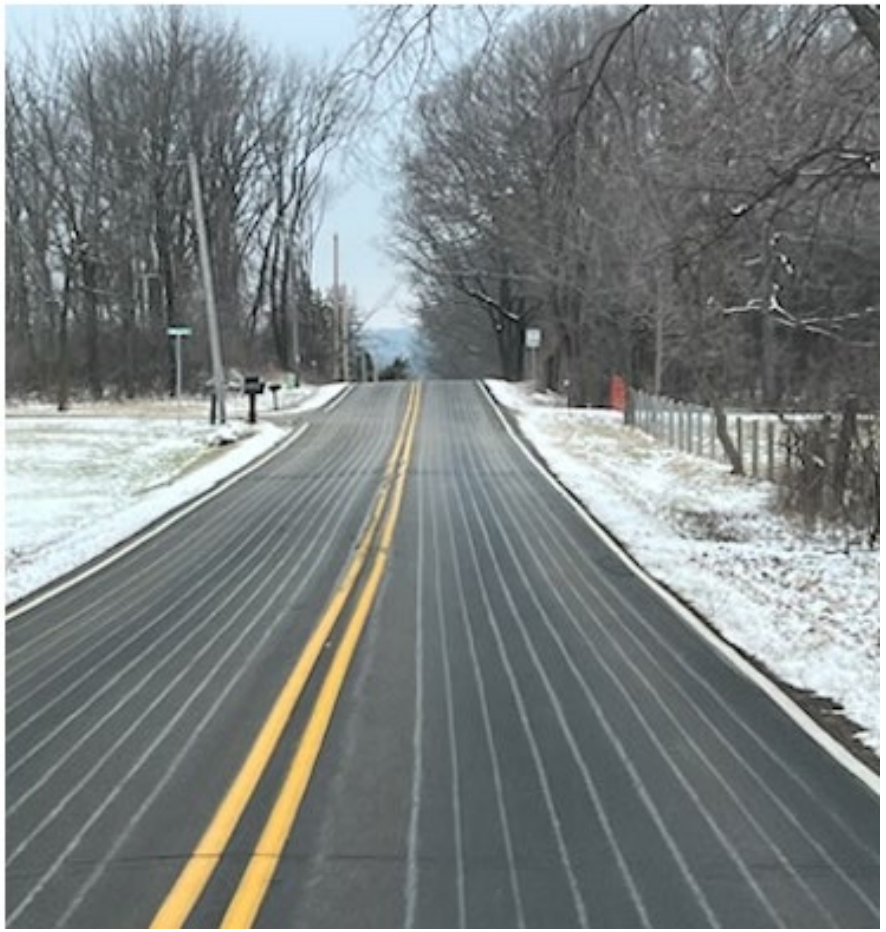
- **Efficiency:** Reduces salt usage by 20-50% and speeds up "time-to-bare-pavement" by 12% (2-3 hours per storm)

Anti-Icing/Pre-Treatment

Timing, Temperature, Techniques

- **Optimal Timing**: Apply 12-18 hours before a snowstorm so brine can stick to pavement and dry. Ideal to apply during low traffic volume.
- **Temperature:** For salt brine, best when pavement is 20°F or higher. Colder temps require other chemicals added to brine.
- **Techniques**: Use streamer nozzles that create "wet/dry" lines 8-12 inches apart; this maintains tire friction while preventing ice bond
- **No-Go Conditions:** Forecasted rain, high wind, or blowing snow

Figure 2.6
Anti-Icing Brine Applied in a Wet/Dry Striped Pattern

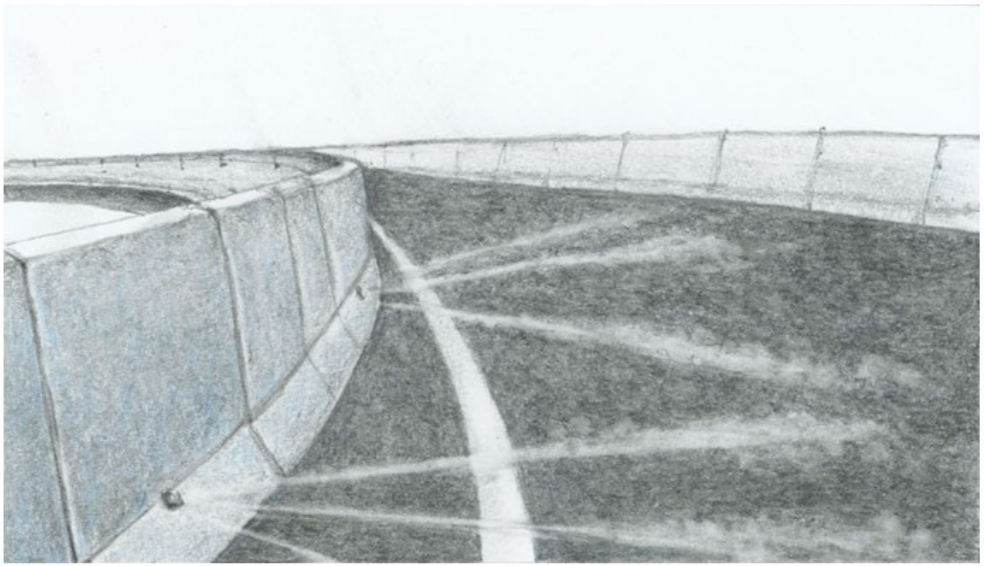


Anti-Icing/Pre-Treatment

Fixed Automated Spray Technology (FAST)

- Permanently installed nozzles and sensors (typically on bridges) that spray anti-icing liquid automatically based on real-time data
- Often uses potassium acetate
- Eliminates the lag time for trucks to arrive at remote or dangerous locations
- Provides 24/7 readiness and lowers overtime
- Reduces bridge accidents by 50-66%
- High installation cost and requires nozzle/sensor maintenance

Figure 2.31
Fixed Automated Spray Technology (FAST) System for Brine Application



Deicing Operations

Deicing Fundamentals

- Reactive strategy used to break the bond between snow/ice and pavement after snow has accumulated
- Goal is *not* to melt all snow, but to penetrate the snowpack and create a brine layer at the pavement surface to allow for easier mechanical plowing
- Remains a foundational strategy in the winter road maintenance toolbox
- Strategic application of right material, in right place, at the right time to achieve intended results

Deicing Operations

Dry Rock Salt Application

- Bulk rock salt is the most common and cheapest winter maintenance material
- **Effective Range:** Pavement temperatures should be above 15°F
- Requires existing moisture and vehicle traffic to activate into brine
- **Bounce and Scatter Problem:** Approximately 30% of dry salt can be lost to bounce/scatter/wind

Pre-Wetted Rock Salt Deicing

- Coating granular rock salt with liquid solution before application on the roadway (typically 8 to 15+ gallons/ton)
- **Less Waste**: Greatly reduces losses due to bounce and scatter
  - Pre-wetted salt is heavier and stickier allowing it to adhere to the pavement better
  - Resists being blown off road by traffic activity
  - Field Study: 80% of pre-wetted salt remained on heavily traveled road while only 15% of dry salt remained
- **Faster Acting:** Liquid coating jump starts activation of salt
- **Less Salt:** Reduce salt usage by 25 to 30 percent without reducing safety

Table 2.3
Typical Pre-Wetting Agents and Practical Working Temperatures

Chemical	Practical Working Temperature	Best Used When
Salt Brine (NaCl)	Above 15°F	Conditions are mild. Standard brine is the most cost-effective choice but freezes or becomes slushy below this range.
Magnesium Chloride ($MgCl_2$)	Down to -10°F	Temperatures drop below 15°F. It is often preferred over calcium chloride because it is less corrosive to metals.
Calcium Chloride ($CaCl_2$)	Down to -20°F	Temperatures are extremely cold. It is the most powerful common deicer for speed and low temperatures but is generally more expensive and corrosive than magnesium chloride.

Source: Clear Roads

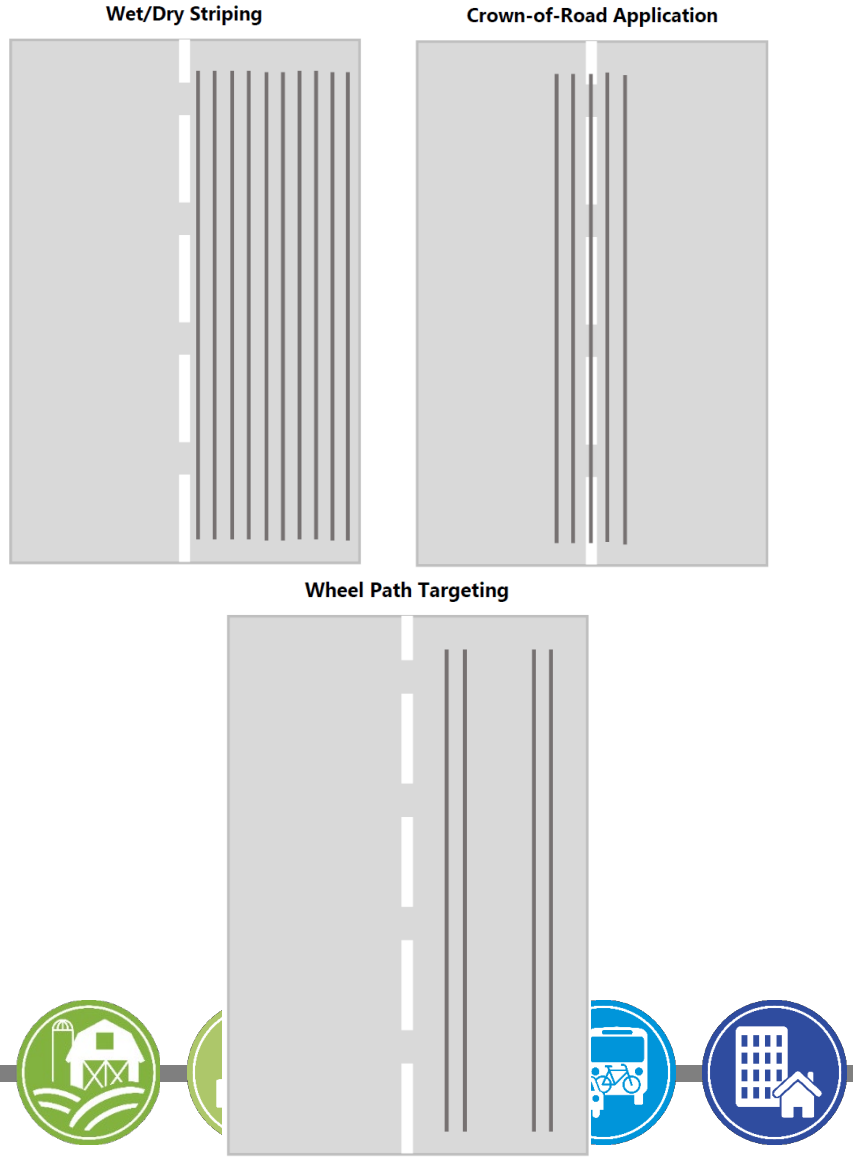
"Shake and Bake" Application

- High-volume pre-wetting using 40+ gal/ton
- Creates an oatmeal-like slurry
- Can work 30-45 minutes faster than dry salt
- Best Uses:
  - Breaking through hardpack caused by heavy traffic allowing for easier plowing
  - Colder temperatures
  - High winds and high-speed traffic
  - Rush hour recovery (clearing lanes quickly before traffic creates hardpack)

Direct Liquid Application (DLA)

- Sprays liquid agents directly onto accumulated snow
- Minimizes loss of material
- Quicker melting action – "live fast, die young"
- Effective for:
  - Light snow
  - Storms with rapid cycle times (plows returning every 60-90 minutes)
- Studies: 23%-44% less salt, 12% faster to "bare/wet" pavement
- Jefferson County, WI is a pioneer in DLA

Figure 2.9
Direct Liquid Application Spread Patterns for Public Roadways



Deicing and Anti-Icing Application Rates

- **Goal:** Apply only amount needed to achieve desired results
- **Variables:** Material type, method, pavement temperatures and trends, storm intensity, and cycle times
- Guidance should be treated as a starting point and should be adjusted based on local experiences and community needs
- See tables in **Appendix A** for application rates based on storm type, intensity, and pavement conditions

Table 2.4
Recommended Road and Highway Deicing Application Rates Based on Road Temperature

Road Temperature	Pre-Wetting (lbs/lane mile)[a, b]	Dry Rock Salt (lbs/lane mile)	Shake and Bake Liquid Component (gal/lane mile)	Shake and Bake Granular Component (lbs/lane mile)
30°F+	100-150	150-200	40+	100
25-29°F	150-200	200-250	40+	150
20-24°F	200-250	250-300	40+	150
15-19°F	250-300	300-350	40+	200
Salt Brine Blend – 80/20 with Organic Agent[c] or 90/10 with Calcium Chloride		Not Recommended	Salt Brine Blend – 80/20 with Organic Agent[c] or 90/10 with Calcium Chloride	
5-14°F	250-350		50	200

Winter Maintenance Equipment & Technology

Monitoring and Sensing Technology

Maintenance Decision Support Systems (MDSS)

- **Integrates** atmospheric weather forecasting, real-time pavement conditions, and specific agency operational rules and strategies
- **Provides** route-specific recommendations: optimal timing, appropriate material type, suggested application rate
- **Benefits:** Improved safety, better coordination and consistency, increased resource efficiency, cost savings, and reduced environmental impacts

Monitoring and Sensing Technology

- Road Weather Information Systems (RWIS)
  - Collect, process, and distribute real-time weather and road condition data
- In-Road Pavement Sensors
  - Measure surface temperature, wetness, chemical concentration remaining on the roadway, precise freezing point with consideration of deicing chemicals
- Mobile Infrared Sensors
  - Monted on plow and deicing trucks serve as rolling data collection points
  - Use Automated Vehicle Location (AVL) systems to aggregate sensor readings with location
  - Provide info to MDSS or to driver to assist with application decisions

Figure 2.10
Typical Road Weather Information System (RWIS) in Wisconsin

Figure 2.11
Truck-Mounted Mobile Infrared Pavement Temperature Sensor and In-Cab Display

Sensors are typically mounted on side mirror

In-cab display

Mechanical Snow Removal Equipment

Plow Configurations

- Front-Mounted Plows
  - One-Way
  - Reversible
- Wing Plows
- Underbody Scraper
- Tow Plow

Figure 2.12 Examples of Front-Mounted Plows

One-Way Plow

Reversible Plow

Figure 2.13 Front-Mounted Reversible Plow with Wing Plow Attachment

Figure 2.14 Example of an Underbody Scraper Snowplow

Figure 2.15 Example a Tow Plow Attachment with Solid and Liquid Application System

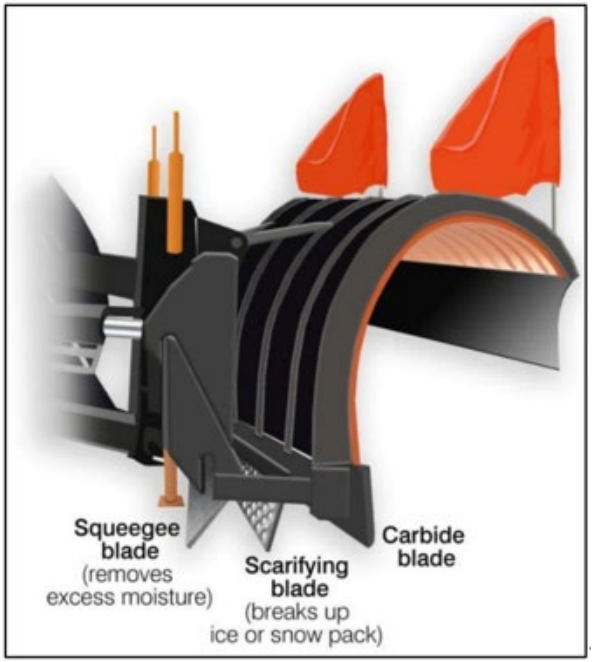
Advanced Blade Technology

Cutting Edges

- Sectional/Segmented Blades
- Live Edge Blades
- Multi-Blade Systems

Figure-2.16¶
View-of-Sectional-Blades-on-a-Front-Mounted-Plow¶

Figure-2.18¶
Prototype-Drawing-of-a-Multi-Blade-Configuration¶



Source:·Iowa·Department·of·Transportation·and·Clear·Roads¶

Figure-2.17¶
Live-Edge-Blades-on-a-Front-Mounted-Plow¶

Material Application Systems

Electronic Spreader Controls

- **Centralized Command**: In-cab interface synchronizes hydraulics with real-time operational data to ensure accurate application
- **Universal Software:** Software supports granular, pre-wet, and direct liquid applications
- **Groundspeed Automation:** Automatically adjusts material output based on vehicle velocity to maintain consistent rates
- **Integrated Telematics:** Logs material types and application rates; Provides spatial reporting when paired with Automatic Vehicle Location
- **Dynamic Spreading Systems:** Use real-time environmental data to automatically adjust material output as truck moves. Linked to MDSS to react to the road conditions and receive recommended application rates from a cloud-based model

Equipment Calibration & System Precision

- Measures amount of material discharged at various settings in relation to a truck's speed
  - Ensures volume of material discharged matches the "set point" on the controller
- Uncalibrated equipment commonly results in application errors of 20% to 50%
  - City of Cudahy achieved a 46.5% reduction in salt use and $60,000 in annual saving through rigorous calibration
- Operational Calibration Schedule:
  - Mandatory when equipment put into service and at start of every winter season
  - Required after any equipment repairs, controller changes, or when replenishing stockpiles (material gradation varies)
  - Spot-check during season
- Calibration processes differ based on technology levels:
  - Manually controlled systems, Open-loop systems, or Closed loop systems

Other Chloride Management BMPs

- Snow Storage Area Siting and Management
- Roadside Vegetation Management to Leverage Solar Radiation
- Salt Take-Back Programs
- Truck Wash Wastewater Reclamation and Reuse

Potential Future Advancements

- Heated Pavements
- Electrically Conductive Concrete
- Phase Change Pavement Materials
- Solar Roadways and Walkways

Local Success Stories

- **Major Chloride Reductions:** Many communities have achieved reductions in salt use of 50% or more
- **Economic ROI:** Modernization in Oak Creek and Cudahy generated annual savings between $60,000 and $120,000, proving that salt reduction efforts quickly pay for themselves
- **Concurrent Safety Improvements:** Walworth County cut salt use in half while rising to the top in regional safety rankings, showing that environmental and safety goals are compatible
- **Scalable "DIY" Innovation:** Small municipalities like the Village of Walworth achieved 90% salt use reductions per storm using repurposed equipment and custom-built brine systems for as little as $1,200
- **Data-Driven Decision Making:** Slinger and Oak Creek replaced subjective assessments with real-time pavement sensors and professional training to optimize material application

Questions?

Private Winter Maintenance Practices

Private Winter Maintenance Practices

- Chloride from private practices can be a significant source of chloride loading
- Contracted winter maintenance practitioners
  - Private roads
  - Parking lots
- Individual homeowners
  - Residential driveways and walkways
  - Adjacent public sidewalks

Pavement Clearance Expectations

- Users often have expectation of clear pavement immediately after storm event
  - Over application of salt
  - Does not yield higher melting beyond a certain point
  - Reduced traction
- Users can adjust expectations on degree of snow removal and timeframe
  - Can adjust driving behavior in snowy conditions
    - Reduce speed
    - Brake early
  - Stay home
- Wear footwear that provides adequate traction

Photo credit: Flicker user icegripper

Pavement Clearance Expectations

- Property owners can also adjust expectations for contractors
  - Use anti-icing material prior to storm
  - Allow longer time window granted to applicator to regain bare pavement
    - Can allow up to 48 or 72 hours rather than 24 hours

- Request service provider apply salt at a specified lower rate

Recommended Application Rates – Private Roads and Parking Lots

- Many factors impact recommended application rates
  - Type and amount of precipitation
  - Pavement materials
  - Pavement temperature
  - Deicing or anti-icing materials to be used
  - Temperature trend
- No one single recommended application rate
- Pre-wetted salt: 2.5 lbs/1,000 ft^2
- Liquid brine: 0.7 gal/1,000 ft^2
- Dry rock salt: 3.5 lbs/1,000 ft^2
  - Significantly lower than current rates of 6-14 lbs/1,000 ft^2

Calibration

- Essential aspect of applying de-icing materials
  - Actual application rate vs. intended rate
- Training programs can teach shop managers correct calibration methods across entire fleet
- Check calibration throughout the winter and adjust accordingly
- Equipment should have the means to measure amount of material applied
  - Not present on all equipment
  - Helps identify if equipment is calibrated properly

Slip and Fall Liability

- Common reason for over-application of salt
  - Maintenance contractors
  - Property owners
- Certification program with a liability waiver would offer protection
  - Training program for best management practices (BMPs)
    - Calibration
    - Anti-icing
    - Recommended application rates
  - Liability protection when using BMPs

Slip and Fall Liability – Case Studies

- "Green SnowPro" program in New Hampshire
  - Training course
    - Completion of exam
    - Recurring courses and exams
  - Benefits include:
    - Liability protection
      - Contractors
      - Property owners
    - Marketing advantage as "green" company
    - Potential lower insurance premiums
  - Preliminary data showed a 30% decrease in salt use
- Wisconsin Senate Bill 52 in 2023 was similar to NH program
  - Passed by legislature but vetoed by governor
    - Too broad of liability immunity
    - Lack of funding framework

Private Driveways and Sidewalks

- Can be among the most over-salted surfaces
- Salting primarily done by individual homeowners
  - Lack of information on:
    - Recommended salting rates
    - Best management practices
      - Anti-icing
      - Calibration of spreaders
    - Typically hand-spread salt rather than use rate-controlled spreader
- Education on proper salting rates and techniques

Recommended Application Rates – Private Driveways and Sidewalks

- Several factors determine recommended rate
- Pre-wetted salt: 3.3 lbs/1,000 ft^2
- Liquid brine: 0.6 gal/1,000 ft^2
- Dry rock salt: 3.6 lbs/1,000 ft^2
  - 12-oz coffee mug volume over 20-ft long driveway
  - 10 standard sidewalk squares

Sidewalk Deicing Ordinance Case Study

- City of Madison, WI, amended ordinance in 2022 to limit salt use on sidewalks and timing for snow removal
- Snow and ice removal by noon of the day following snowfall
- Excess salt must be removed following snow or ice melt
- Policy violations can be reported to City
  - Site inspection
  - Fine of $20-50 for first offense and $30-100 for subsequent violations
- Moderately successful in reducing salt use
- Ongoing enforcement challenges
    - Elapsed time between complaint and inspection
    - Changing weather conditions
    - Salt can get displaced

Alternatives to Chemical Deicing

- Timely mechanical removal
- Traction enhancement
- Heated pavement
- Porous pavement
- Low salt infrastructure design

Timely Mechanical Removal

- Shoveling, snowblowing, or plowing during or directly after event
- Timing is critical to clear before compaction from vehicles or pedestrians
- Anti-icing before event can facilitate snow removal
- Bare pavement can be quickly regained with timely snow removal and direct sun exposure

Traction Enhancement

- Help improve traction for motorists and pedestrians
  - Sand
  - Gravel
  - Finely crushed stone
  - Cinders
  - Ore tailings
- Applied on top of snow or ice
- Traction reduction when applied to bare pavement
- Commonly used on critical areas such as hills, intersections, curves, and pedestrian areas
- Works at very cold temperatures

Photo credit: Flicker user icegripper

Traction Enhancement - Disadvantages

- Not viable for porous pavement
- Negative impacts on aquatic ecosystems
  - Fill voids in gravel and other substrates
  - Increase turbidity
  - Increase sedimentation
- Accumulate in stormwater infrastructure
  - Ponds, catch basins, and sewers
  - Decrease capacity and functionality
  - Increase maintenance costs
- Most of these concerns can be alleviated by sweeping up the material after the snow and ice melt

Heated Pavement

- Heating elements installed underneath the pavement
- Two main technologies
  - Hydronic heating
  - Electric coil heating
- Hydronic heating circulates hot fluid through piping
- Heating from boilers using natural gas or renewables, geothermal, or solar energy
- Higher upfront cost but lower operating costs

Heated Pavement – Electric Coil Heating

- Electric heating cables underneath pavement
- Heats pavement similar to hydronic heating
- Lower installation cost
- Higher operating costs due to large energy consumption

Heated Pavement Considerations

- Heating elements can span entire driveway or only a portion
  - Ice may buildup on non-heated portions
  - May need to shovel or salt
  - Could lose a portion of expected chloride reduction
- Driveway should be designed to divert meltwater to safe location
  - Avoid refreezing on pedestrian surfaces
  - Meltwater should not contain chloride
- May need to remove pavement when system repairs are needed

Porous Pavement

- Typically used for stormwater control
- Rapid surface drainage reduces deicing needs, up to 77%
- Proper design and maintenance is critical
  - Adequate depth and size of base course to accommodate freezing while still infiltrating
  - Maintenance periodically to remove sediment
- Shoveling or snowblowing only
  - If plowing, raise plow height
  - No salt or sand
- Great option for heated pavement

Low Salt Infrastructure Design

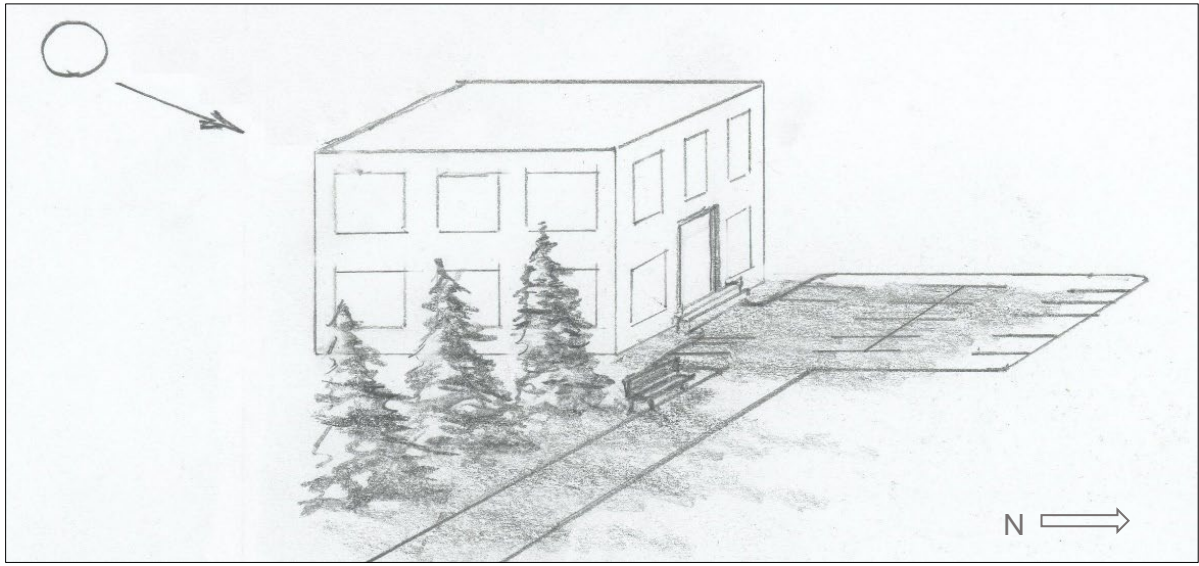
- Utilize site layout to reduce salting needs

- Two main goals:
  - Improve melt time through direct sunlight
  - Eliminate accumulation of blowing snow and meltwater on pavement

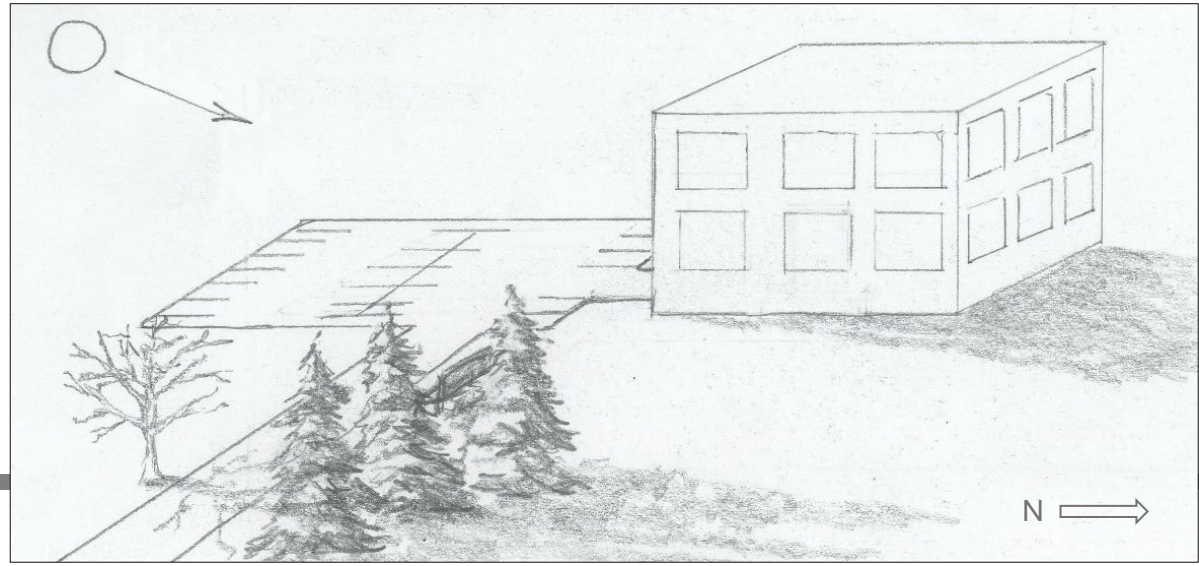
Direct Sun Exposure

- Trees along southern edge
- Deciduous trees on northern edge
- Benches, signs, etc. along southern edge
- Main entrances with southern exposure
- Parking lots on southern side of building

High Salt Design



Low Salt Design

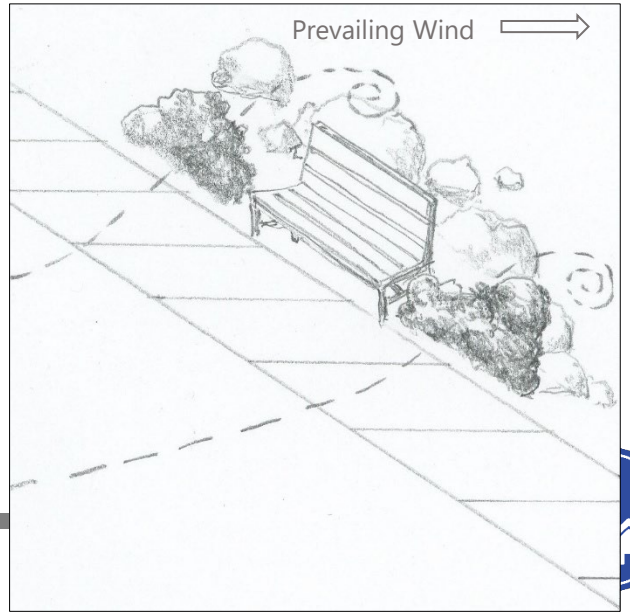


Prevailing Wind

- Bushes, benches, signs, etc. can create a snow fence effect
- When on windward side of walkway, snow deposits on pavement
- Locate on downwind side

High Salt Design

Low Salt Design



Manage Overland Drainage

- Meltwater across pavement can refreeze and be a hazard
- Locate snow storage locations at down-grade locations near curb cuts or other runoff discharge points

Photo credit: Wikimedia user Tony Webster

Manage Vertical Drainage

- Pertains to discharge from downspout
- Avoid discharge onto paved surfaces
- Discharge onto landscaped areas

High Salt Design

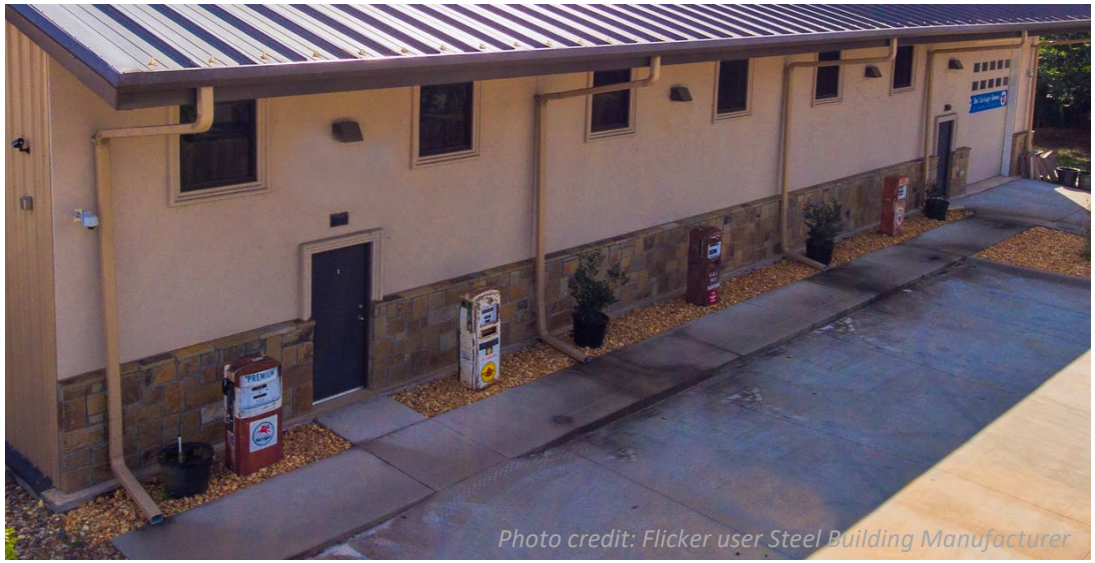


Photo credit: Flicker user Steel Building Manufacturer

Low Salt Design

Photo credit: Flicker user ArmchairBuilder.com

Parking Lot Design

- Avoid excess and irregularly-shaped islands and peninsulas
  - Makes an "obstacle course" for plows
  - Increased salt use
- Design lots with larger open areas and consistent layouts

High Salt Design

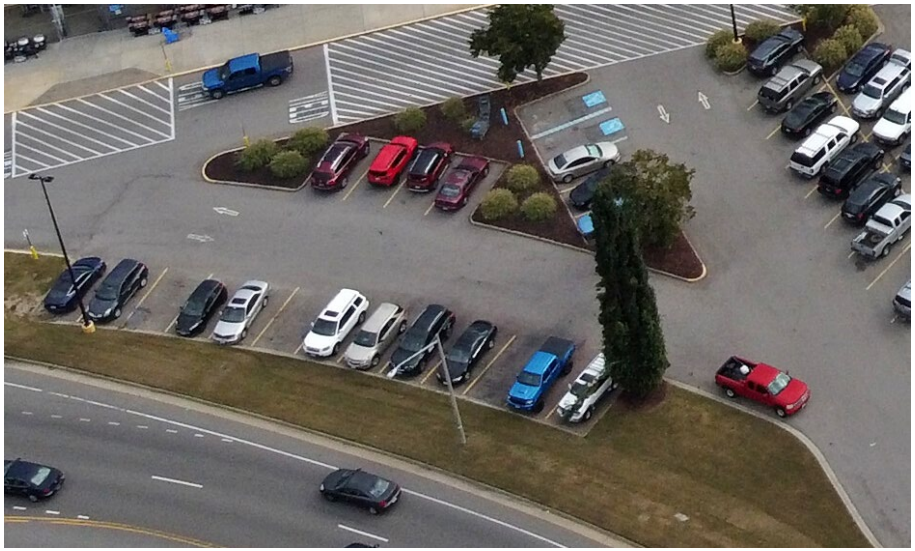


Photo credit: flicker user Ben Schumin

Low Salt Design

Photo credit: flicker user sgiambe

Questions?

Chloride Impact Study – Next Steps

- Comments on the draft chapter can be sent to Laura (lherrick@sewrpc.org)
- Comments are due by April 30, 2026

Chloride Impact Study – Next Steps

- Anticipate next TAC meeting in early summer 2026 to begin review of draft chapters of PR-57
- Meeting agendas, presentations, and summary notes along with draft text are posted on project website

  www.sewrpc.org/chloride-study

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Thank You

Laura Herrick | Chief Environmental Engineer

lherrick@sewrpc.org | 262.953.3224

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