



NWSRG Winter Service Guidance

APSE Winter Maintenance Forum 2019

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NWSRG

NATIONAL WINTER SERVICE RESEARCH GROUP

What has changed & why?

- Responded to feedback on earlier guidance
- Smarter professional publication, courtesy of the IHE
- Checklist to remind of key issues
- Coloured text for warnings & benefits
- Shorter main sections with appendix for more technical supporting material
- Easier to read and digest
- Less quantitative and more qualitative
- Simpler with some wider tolerances
- Embracing a risk-based approach
- **BUT underlying science has not changed**

CONTENTS

SECTION 4 - SALT STORAGE

- 4.1 INTRODUCTION
- 4.2 THE OPTIMUM CONDITION OF SALT FOR SPREADING
- 4.3 ACTIONS WHEN SALT OUTSIDE THE OPTIMUM MOISTURE CONTENT RANGE
- 4.4 OPTIMUM WAYS TO STORE SALT
- 4.5 SALT STORAGE QUANTITIES REQUIRED FOR RESILIENCE
- 4.6 STORAGE PROVISION AND PREPARING STORAGE AREAS
- 4.7 STORAGE AREA DRAINAGE AND ENVIRONMENTAL REQUIREMENTS
- 4.8 PRIORITISING SALT STORAGE WHEN COVERED STORAGE IS LIMITED
- 4.9 STORAGE OF STRATEGIC SALT STOCKS
- 4.10 SPREADER LOADING

ANNEXES

- CALCULATING STORAGE SPACE REQUIREMENTS
- CONSTRUCTION REQUIREMENTS FOR SALT STORAGE FACILITIES
- HOW AND WHEN TO CHECK SALT CONDITION
- CHECKLIST FOR STORING AND MAINTAINING SALT STOCKS

KEY

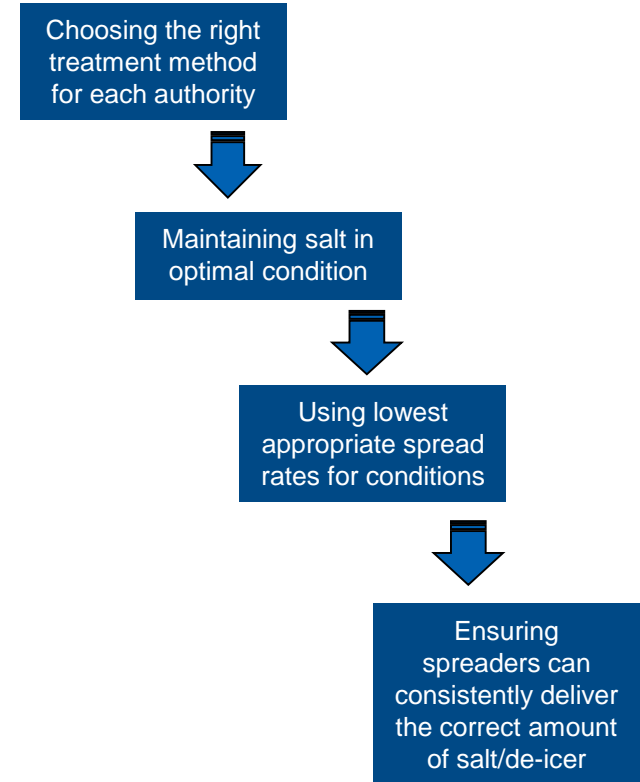
- Red text are warnings or especially important information
- Green text are particular recommendations or key advantages to consider

CHECK LIST:

- How is salt moisture being managed to ensure it is being maintained within its optimum range?
- Do current salt storage capacity and mutual aid arrangements provide adequate resilience?

Principals behind the new guidance

- Encouraging best practice in winter service based on:
 - Science and research
 - Experience from practitioners
 - What the industry can deliver
 - What is practical
- Spread rates
 - Identifying lowest appropriate spread rates
 - Identifying how they can be achieved practically
- Risk-based approach (RBA)
 - Identifying where a risk based approach may be appropriate
 - Providing supporting evidence
 - Quantifying risk and identifying mitigation
 - Balancing of risk based on finite resources
 - Example: banding of spread rates to local climate



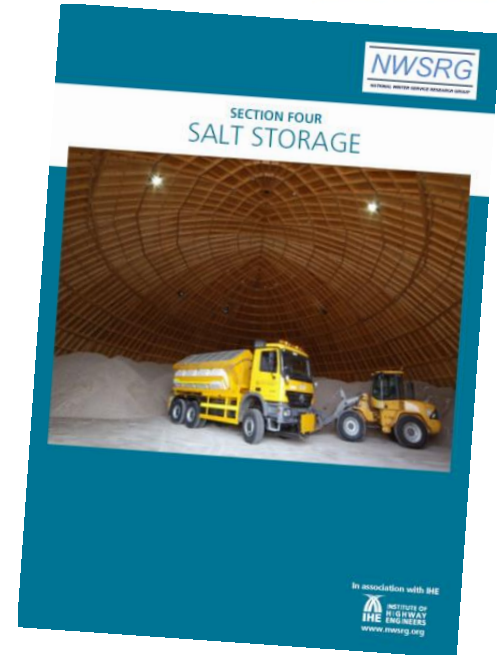
Salt Storage

Key questions:

How is salt moisture being managed to ensure it is being maintained within its optimum range?

Do current salt storage capacity and mutual aid arrangements provide adequate resilience?

- Salt moisture content should be controlled and monitored
- Optimal moisture content range has been extended (and linked to fines content if dry salting)
- Resilience levels should consider time to restock
- Useful data contained within appendix



UK rock salt, Marine Salt and imported rock salt (fines under 7.5%)	Dry salting	1.5 to 4%
UK rock salt, Marine Salt and imported rock salt (fines over 7.5%)	Dry salting	2 to 4%
UK rock salt	Pre-wetted	Less than 4%*
UK rock salt	Treated	Less than 4%*

Treatment Methods & Technologies

Key questions:

Have you considered alternatives to the de-icing materials you have been using to date? Cost-benefit analyses may indicate efficiency savings and lower spread rates could potentially lead to improved resilience.

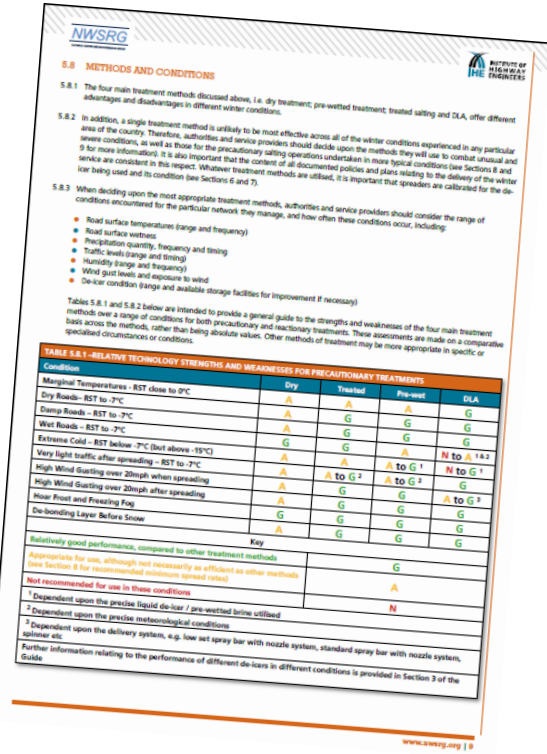
Have you considered the performance of the different spreading technologies in the weather conditions your area experiences?

- New section to the guidance
- Considers:
 - Dry salt
 - Treated salt
 - Pre-wet salt
 - Direct liquid applications



Treatment Methods & Technologies

TABLE 5.8.1 –RELATIVE TECHNOLOGY STRENGTHS AND WEAKNESSES FOR PRECAUTIONARY TREATMENTS				
Condition	Dry	Treated	Pre-wet	DLA
Marginal Temperatures - RST close to 0°C	A	A	A	G
Dry Roads– RST to -7°C	A	G	G	G
Damp Roads – RST to -7°C	A	G	G	G
Wet Roads – RST to -7°C	G	G	A	N to A ^{1 & 2}
Extreme Cold – RST below -7°C (but above -15°C)	A	A	A to G ¹	N to G ¹
Very light traffic after spreading – RST to -7°C	A	A to G ²	A to G ²	G
High Wind Gusting over 20mph when spreading	A	G	G	A to G ³
High Wind Gusting over 20mph after spreading	A	G	G	G
Hoar Frost and Freezing Fog	G	G	G	G
De-bonding Layer Before Snow	A	G	G	G
Key				
Relatively good performance, compared to other treatment methods			G	
Appropriate for use, although not necessarily as efficient as other methods (see Section 8 for recommended minimum spread rates)			A	
Not recommended for use in these conditions			N	
¹ Dependent upon the precise liquid de-icer / pre-wetted brine utilised				
² Dependent upon the precise meteorological conditions				
³ Dependent upon the delivery system, e.g. low set spray bar with nozzle system, standard spray bar with nozzle system, spinner etc				
Further information relating to the performance of different de-icers in different conditions is provided in Section 3 of the Guide				



Spreader Management

Key questions:

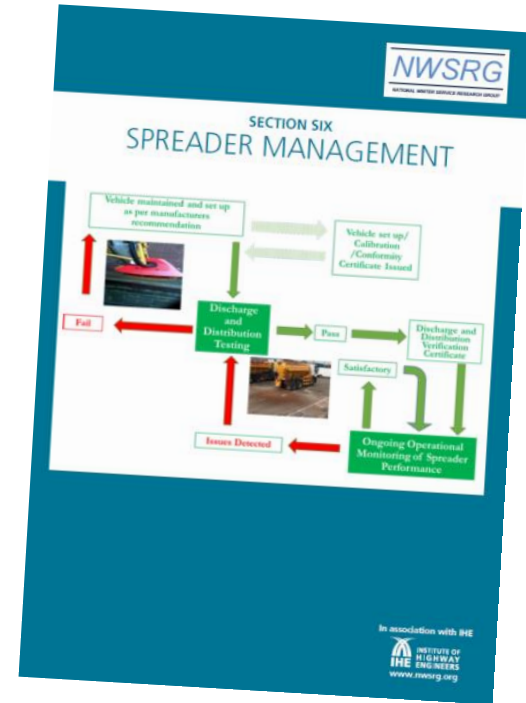
Is the spreader manufactured in accordance with current standards?

Is the calibration up to date?

Has the distribution been assessed and recorded?

Is the performance being monitored?

- Ensuring the correct amount of salt is being spread in the correct pattern
- Not just calibration – ongoing management
- **No longer a “poor” calibration**
- Removed 4 month calibration recommendation
- Added recommendation for continuous monitoring



Spreader Management

- **Key Spreader Standards**
- Spreaders should be manufactured in accordance with BS 1622 and/or draft Euro Standard EN 15597-2.
- Any spreader compliant with the above should be capable of being successfully calibrated to **'good'** or **'fair'** by following the guidance.
- Where this cannot be achieved, the spread rates guidance cannot be followed and the user should make their own risk assessment regarding usage of the spreader.



Spreader Management

- Effective calibration and monitoring provides confidence that spreaders are performing correctly and allows lower spread rates to be used with a reduced risk of under-salting.
- This process comprises :
 - Vehicle Mechanical Check - Pre Test Check on all key vehicle / body parts
 - Calibration / Conformity - Independent
 - Dynamic Testing – In House (after training) or Independent
 - Discharge Test
 - Distribution Test
- Records must be made and retained



Spreader Management

- DISCHARGE TESTING
 - Detail Spread Rate
 - Detail Spread Speed
 - Detail Spread Width
 - Detail Time Period
 - Calculate theoretical
 - Check actual against theoretical



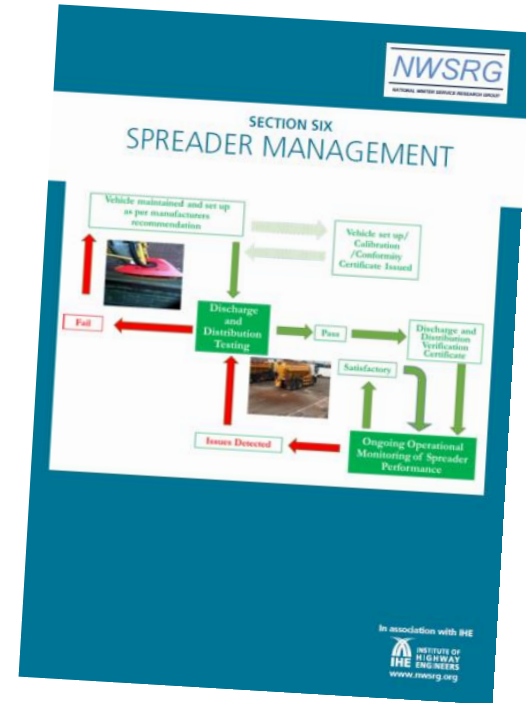
Spreader Management

- SALT DISTRIBUTION
- Understand what to look for



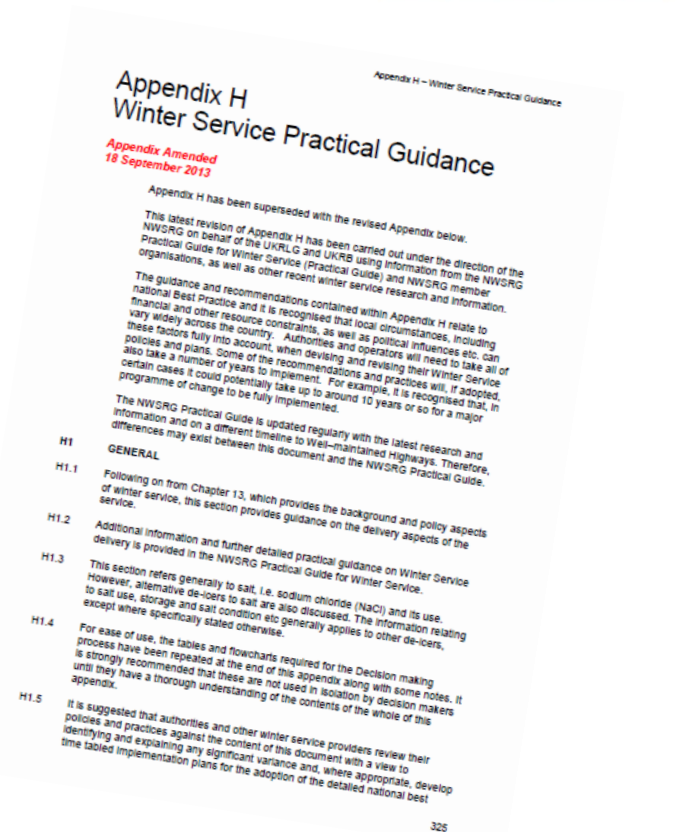
Spreader Management

- Monitoring during the season is important
- The process may well vary by authority, dependant on their operational practices and facilities, but should include:
 - Continual checks with the operators:- are there any issues with the machines?
 - Checks of tracking data and records to ensure records are correct and no data is missing, salted areas missed etc
 - Checks of actual salt usage against theoretical
 - Checks that spread pattern remains correct
 - Checks of salt quality and moisture
 - Vehicle checks and services at regular intervals
 - Findings are recorded



Spread Rates for Precautionary Salting

- **Previous Guidance (WMH Appendix H)**
- Scientifically determined minimum recommended spread rates
- 12 spread rate matrices (A to L)
- Determining applicable matrix could be challenging in some situations
- Amongst others, the variables included: Treatment type (Dry, Treated, Pre-wet); Coverage (Good, Fair, Poor); Traffic Level (Medium, High); and losses after spreading (Normal, High)
- Authorities had difficulty in directly applying the recommended minimum spread rate matrices to their operations
- Some developed their own matrices based on the recommended minima but adapted to local circumstances
- **Many requested that the guidance be simplified!**



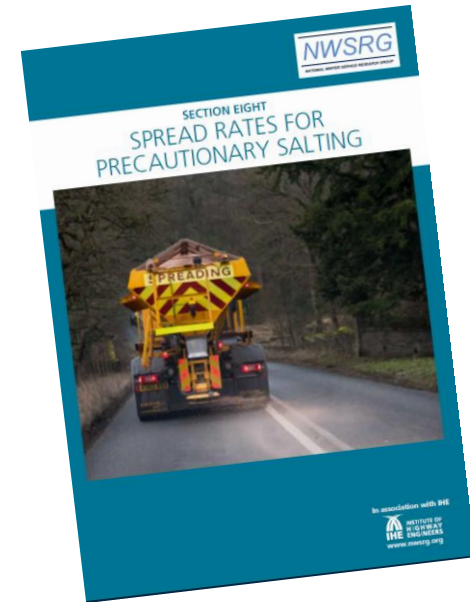
Spread Rates for Precautionary Salting

Key questions:

Has the guidance in other sections of the NWSRG Practical Guide, been properly considered?

Does the process for determining precautionary spread rates on your network follow an appropriate risk-based approach?

- **3 simplified spread rate tables, based on most common requirements (e.g. medium traffic)**
- Recommended rates are similar to those contained in previous guidance and are similarly scientifically based and robust. However, the tables and key notes are simpler to apply and are more practicable.
- Temperature bands have changed, providing greater flexibility for authorities to choose their own temperature banding
- Includes interim guidance on brine spread rates



Spread Rates for Precautionary Salting

TABLE 8.3.3 AMOUNT OF SALT REQUIRED IN SOLUTION ON A ROAD SURFACE TO PREVENT ICE FORMING

Road Surface Temperature (°C)	Road Surface Wetness at Forecast Event	
	Damp	Wet
0.0 to -1.0	1g/m ²	2g/m ²
-1.1 to -2.0	2g/m ²	4g/m ²
-2.1 to -5.0	5g/m ²	10g/m ²
-5.1 to -7.0	7g/m ²	13g/m ²
-7.1 to -10.0	9g/m ²	18g/m ²

This is the amount of salt actually required on the ground

Spread Rates for Precautionary Salting

Recommended Spread Rates – Dry Salting (g/m ²) table 8.6.7				
Road Surface Temperature (RST) when frost/ice is predicted	Spreader Capability			
	Fair		Good	
	Dry/Damp Road	Wet Road	Dry/Damp Road	Wet Road
At or above -1.0°C	8	8	8	8
-1.1°C to -2.0°C	8	11	8	8
-2.1°C to -3.0°C	9	17	8	13
-3.1°C to -4.0°C	12	23	9	17
-4.1°C to -5.0°C	14	28	11	21
-5.1°C to -7.0°C	20	39	15	30
-7.1°C to -10.0°C	27	54	20	40
-10.1°C to -15.0°C	38	75	28	56

Spread Rates for Precautionary Salting

Recommended Spread Rates – Treated Salting (g/m²) table 8.6.8

Road Surface Temperature (RST) when frost/ice is predicted	Spreader Capability			
	Fair		Good	
	Dry/Damp Road	Wet Road	Dry/Damp Road	Wet Road
At or above -1.0°C	7	7	7	7
-1.1°C to -2.0°C	7	8	7	7
-2.1°C to -3.0°C	7	12	7	10
-3.1°C to -4.0°C	9	17	7	13
-4.1°C to -5.0°C	11	21	8	16
-5.1°C to -7.0°C	15	29	11	22
-7.1°C to -10.0°C	20	40	16	31
-10.1°C to -15.0°C	26	55	22	43

Spread Rates for Precautionary Salting

Recommended Spread Rates – Pre-Wetted Salting (g/m²) table 8.6.9

Road Surface Temperature (RST) when frost/ice is predicted	Spreader Capability			
	Fair		Good	
	Dry/Damp Road	Wet Road	Dry/Damp Road	Wet Road
At or above -1.0°C	8	8	8	8
-1.1°C to -2.0°C	8	10	8	8
-2.1°C to -3.0°C	8	16	8	12
-3.1°C to -4.0°C	11	21	9	17
-4.1°C to -5.0°C	14	27	11	21
-5.1°C to -7.0°C	19	37	15	30
-7.1°C to -10.0°C	27	53	21	42
-10.1°C to -15.0°C	n/a	n/a	n/a	n/a

Spread Rates for Precautionary Salting

Key guidance notes (examples):

- Rounding – not falling below minimum values but applying a risk based approach for practicality
- Interpolation of temperature bands
- Higher spread rates may be difficult to spread in one pass, depending on optimisation
- Using alternative de-icers at very low temps
- Salt chloride content/moisture content
- Porous asphalt/other negative textured surface/
Bridge decks
- Traffic levels
- Precipitation
- Wind speed
- Residual Salt

Recommended Spread Rates – Dry Salting (g/m ²) Treatment Matrix 8.6.7				
Road Surface Temperature (RST) when frost/ice is predicted	Spreader Capability			
	Fair		Good	
	Dry/Damp Road	Wet Road	Dry/Damp Road	Wet Road
At or above -1.0°C	8	8	8	8
-1.1°C to -2.0°C	8	11	8	8
-2.1°C to -3.0°C	9	17	8	13
-3.1°C to -4.0°C	12	23	9	17
-4.1°C to -5.0°C	14	28	11	21
-5.1°C to -7.0°C	20	39	15	30
-7.1°C to -10.0°C	27	54	20	40
-10.1°C to -15.0°C	38	75	28	56

8.6.8 Precautionary Spread Rates for Treated Salting

The matrix below provides recommended spread rates for precautionary treated salting operations on local authority roads in response to predictions of ice and frost formation.

Treated salt incorporates an additive designed to improve performance and distribution, as well as reducing the rate of salt loss after spreading. Before adopting the treated salt spread rates in the matrix below, authorities should therefore satisfy themselves that the material is suitable for purpose and meets the manufacturer's performance claims. This includes manufacturers providing evidence of appropriate independent testing etc.

When utilising these rates, it is crucial that the content of all of the 'Key Notes' above is properly considered, as these notes provide information regarding the interpretation of the matrix and discuss situations when the spread rates should be modified.

Recommended Spread Rates – Treated Salting (g/m ²) Treatment Matrix 8.6.8				
Road Surface Temperature (RST) when frost/ice is predicted	Spreader Capability			
	Fair		Good	
	Dry/Damp Road	Wet Road	Dry/Damp Road	Wet Road
At or above -1.0°C	7	7	7	7
-1.1°C to -2.0°C	7	8	7	7
-2.1°C to -3.0°C	7	12	7	10
-3.1°C to -4.0°C	9	17	7	13
-4.1°C to -5.0°C	11	21	8	16
-5.1°C to -7.0°C	15	29	11	22
-7.1°C to -10.0°C	20	40	16	31
-10.1°C to -15.0°C	26	55	22	43

Spread Rates for Precautionary Salting

Note 5 – Salt chloride content

The spread rates provided in the matrices are based on the use of UK indigenous rock salt. If salt with higher purity is used, spread rates can be reduced. For example, the recommended spread rates can be reduced by 7.5% if salt purity is 99% or higher. However, as discussed earlier in this section, a minimum spread rate of 8g/m² (7g/m² for treated salt) should be maintained in order to account for the inevitable variabilities that occur in coverage and losses.

Note 6 – Salt moisture content

The spread rates provided in the matrices relate to salt exhibiting a moisture content within the optimum range. Information relating to optimum moisture content of de-icing salt is provided in the Salt Storage section of the NWSRG Practical Guide.

For pre-wetted and treated salting, the optimum moisture content is less than 4%.

The optimum moisture content range for dry salting is dependent upon its fines content. Where the maximum fines content (<0.3mm particle size) is less than or equal to 7.5%, the optimum moisture content for dry salting is within the range 1.5% to 4%. Where the maximum fines content is above 7.5%, the optimum moisture content is within the range 2% to 4%.

When undertaking precautionary salting operations with salt that falls outside of the optimum range, the spread rates provided in the matrices should be increased by 20%.

Spread Rates for Precautionary Salting

Note 10 – Traffic levels

The matrices assume 'Medium Traffic' around the time of the precautionary salting operation.

For 'Light Traffic' situations, the spread rates provided in the matrices should be increased by 25%.

Research has shown that salt losses do not increase significantly in 'High Traffic' situations and it is therefore considered that the spread rates provided in the matrices are suitable for use in these situations. However, where authorities maintain roads that regularly fall into the 'High Traffic' category for precautionary salting operations, they may opt to utilise the spread rates developed for Trunk Roads, although it is important to note that these only apply to 'Good' spreader capability.

Undertaking precautionary salting operations in 'Congested Traffic' situations should be avoided whenever practical considerations allow. However, when it is necessary to undertake precautionary salting operations in 'Congested Traffic', the spread rates provided in the matrices should be increased by 20%.

When undertaking precautionary operations in 'Congested Traffic' situations, it may be necessary to implement additional measures to aid the passage of spreaders and/or to consider undertaking additional treatments in order to ensure proper distribution of the de-icers.

Spread Rates for Precautionary Salting

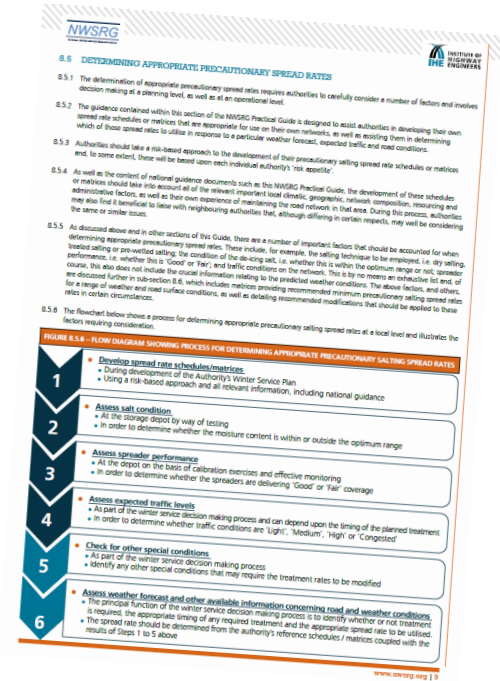
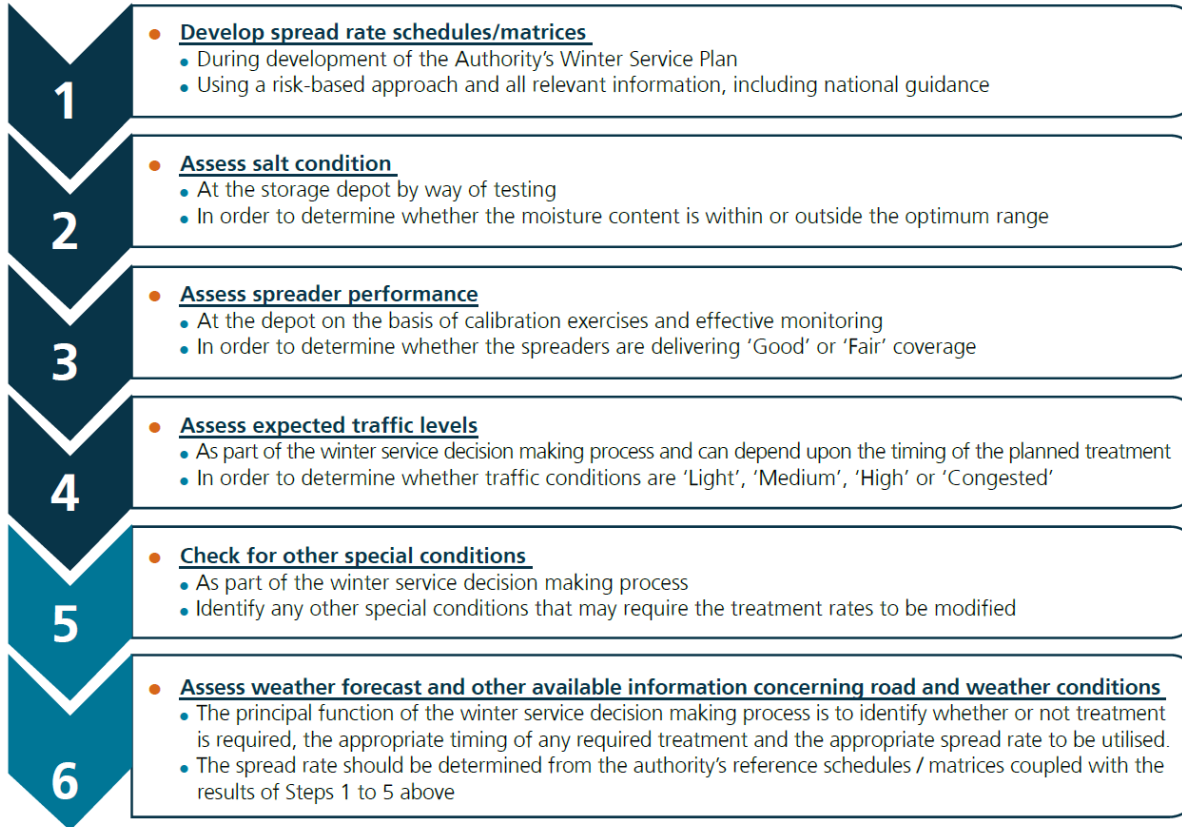
Note 11 – Precipitation

Precipitation will adversely affect de-icing materials on the road surface, reducing their effectiveness and, along with the action of traffic, significantly increase the rate at which they are removed from the road surface. It is therefore recommended that, whenever practicable, treatments are delayed and undertaken after any predicted or actual rainfall has ceased and before freezing road surface temperatures are expected.

It is recognised that a band of frontal rain crossing the area presents a different situation to that of scattered showers, for example, and that it is sometimes difficult, or even impossible, to undertake and complete an operation in the available time period after the cessation of precipitation. In these situations, which can be some of the most challenging of all for decision makers, it will be necessary for winter service decision makers to use their judgement, along with all of the relevant information available to them, to determine the optimum timing for these salting operations.

Spread Rates for Precautionary Salting

FIGURE 8.5.6 – FLOW DIAGRAM SHOWING PROCESS FOR DETERMINING APPROPRIATE PRECAUTIONARY SALTING SPREAD RATES



Treatments for Snow and Ice

Key questions:

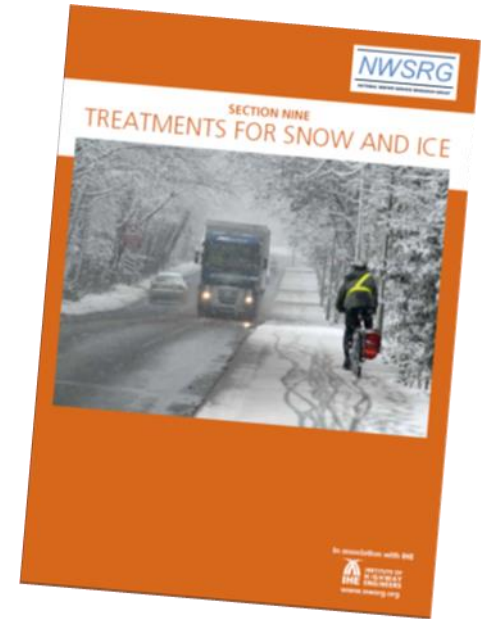
Do you treat in advance of snowfall and freezing rain in order to provide a debonding layer?

Do the plough types and set up allow ploughing down to the road surface (ploughing to black)?

Are drivers trained in correct plough operation, including effective ploughing strategies and, if appropriate, ploughing to black?

Are operational plans in place so ploughs are easily available and ready for fitting?

- Reviewed and updated from practitioner experience
- More information regarding freezing rain
- Accepting limitations of some snow conditions
- Managing risks to personnel in severe conditions



Status of guidance

Section	Existing	New format
Treatment methods and Technologies		Published
Salt Storage		Published
Spreader Calibration		Published
Salting spread rates		Published
Treatments for snow and ice		Published
Treatments for extreme cold	Published	No current review
Planning		Member's review
Decision Making		Drafting
Treatment of Footways and Cycleways		With task group
Weather Forecasting and RWIS		Drafting
Route Selection and Optimisation		With task group



How to find it and what next?

- <http://www.nwsrg.org/publications/guidance>
- Or via link from Well-managed Highway Infrastructure
- Why not join the NWSRG and assist with its work? Ask for details





Contact: nwsrg@trl.co.uk

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