

Winter Service Guidance for Local Authority Practitioners

Recommended Precautionary Treatments and Post Treatments Including Revised Salt Spread Rates

1 INTRODUCTION

An independent review (“the Quarmby Review”), commissioned by the previous government and continued by the current Secretary of State for Transport, to consider the resilience of English transport systems, produced a final report in 2010. Its recommendations aim, *inter alia*, at providing measures to improve local highway authorities’ preparedness for winter. In particular, the review noted a need for ‘research which would underpin recommendations for the adoption of lower salt spread rates [...] to improve resilience of the salt supply chain’ (recommendation 23).

With the early onset of the 2010/11 winter service season, the need for guidance on appropriate spread rates to reduce salt usage on local roads and improve resilience has become a high priority. The Department for Transport believes that it would be helpful to provide simple spread rate guidance to local authority practitioners as a matter of urgency. This document provides the required guidance.

Research has been undertaken by TRL on behalf of the Highways Agency (HA) and the National Winter Service Research Group (NWSRG) into the possibility of reducing spread rates. The findings were that spread rates can be reduced considerably in marginal conditions when salt that is in good condition is being spread by well maintained and/or modern spreaders that are properly calibrated. However, in more extreme conditions, spread rates may need to be increased beyond those recommended in current guidance for UK local roads, particularly for salt in less than optimum condition which is being spread with less capable or poorly calibrated spreaders.

The results of this work have been used to provide a comprehensive range of spread rates for different weather conditions and spreading capabilities for the UK road network. These have been issued through the HA in the “Highways Agency Network Management Manual” for the trunk road and motorway network. More recently, the NWSRG “Practical Guide for Winter Service” has been developed based on this research and backed up by the practical experience of high performing service providers who have added their expertise and peer reviewed the work by TRL. This work (for HA and NWSRG) has been used to produce this new guidance. **Therefore users can have confidence that the advice provided here is sound from both a theoretical and practical point of view.**

Guidance available to local authority practitioners to assist them in preparing their winter service plans includes Section 13 of Well Maintained Highways which sets out the broad context and framework for the winter service, while Appendix H of that document provides details about treatment decisions. More recently, the UKLRG has provided additional guidance, published in October 2010, on its website.

The guidance in this document supplements existing guidance and the information provided here supersedes information given in Appendix H – Sections H7 and H8 - Winter Service

Issues of Well Maintained Highways including tables H2 & H3. Therefore this document replaces Sections H7 and H8 of Appendix H and also adds Section H10 for snow treatments.

What is in this document?

Section 2 - defines Precautionary Treatments and Post Treatments, and describes monitoring requirements.

Section 3 - discusses the decision making process, including:

- definitions of road surface wetness
- definitions of traffic levels
- a decision matrix to determine appropriate treatments based on weather and road surface conditions
- a decision matrix to determine spreading capability

Therefore Section 3 replaces Section H7 of Appendix H of Well Maintained Highways and is referenced accordingly.

Section 4 - provides the recommended spread rates for precautionary treatments in response to forecast frost conditions

Therefore Section 4 replaces Section H8 of Appendix H of Well Maintained Highways and is referenced accordingly.

Section 5 - describes precautionary and post-treatments which are appropriate

- in response to forecast snow or freezing rain during snowfall
- when slush is on the road (and may refreeze)
- for thin layers of ice (up to 1mm thick)
- for thicker layers of ice or compacted snow

Therefore Section 5 adds Section H10 of Appendix H of Well Maintained Highways and is referenced accordingly.

Section 6 - provides reference links to other guidance and relevant documents

2 TREATMENT AND MONITORING

This section describes the treatments considered in this guidance, the reasoning used to determine spread rates and the monitoring required to check their effectiveness.

Precautionary treatments

These are the application of de-icers to road surfaces before the onset of freezing conditions (i.e. frost, snow or freezing rain). The purpose of precautionary treatments is to prevent the formation of ice, or to weaken or prevent the bond of freezing rain or snow to road surfaces.

It is usually impractical to spread sufficient salt to melt freezing rain or more than a few millimetres of snow. Therefore, in advance of forecast snow or freezing rain, salt is spread to provide a debonding layer so that:

- snow is more readily removed by ploughing
- compacted snow and ice are more easily dispersed by traffic

It is very difficult to remove a layer of compacted snow or ice that is bonded to the road surface, so precautionary treatments are essential before heavy snowfall.

Spread rates for precautionary treatments

The majority of winter service treatments (and salt spread) in the UK are precautionary treatments in response to predicted frost conditions. In these, commonly marginal conditions, significant salt savings can be achieved using the rates given in this guidance when using salt which has been stored in good conditions, and using good equipment which has been properly calibrated. The use of pre-wetted or treated salt can also provide salt savings compared to dry salting.

For precautionary treatments when frost conditions are forecast, this guidance gives two tables of spread rates – one with low spread rates and one with higher spread rates (see Section 4). The appropriate rates to use depend upon the spreading capability, which depends on the condition of the salt, spreader performance and calibration. The lower spread rates are used where the spreading capability is deemed to be '*reasonable*', and the higher rates are used where the capability is '*modest*'. A simple method of determining spreading capability is described in Section 3.

For more information on salt storage and spreader calibration refer to *Winter Service Guidance for Local Authority Practitioners*- [web link](#)

Post treatments

Post treatments involve the ploughing of snow, the application of de-icers and the application of abrasives to ice and snow present on the road surface, or some combination of these.

Although de-icers will melt ice or snow directly, it is normally impractical to apply sufficient quantities of de-icer to melt all of a moderately thick ice or snow layer.

Ploughing is the only economical, efficient, effective and environmentally acceptable way to deal with all but very light snow.

Monitoring

The condition of routes should be monitored following treatment in order to confirm that the treatment has been effective. If it has not been fully effective, contingency treatments should be considered to achieve the required condition. It should be noted that both active and passive road weather sensor systems require the presence of moisture to determine either the concentration of an anti-icing chemical on the road or the freezing point temperature of the solution present on the road sensor.

3 DECISION MAKING PROCESS

This section replaces the current Well Maintained Highways – Appendix H - Section H7

H7 DECISION MAKING PROCEDURE

H7.1 A suggested procedure for decision making, taking into account various operational scenarios is provided in this section. This procedure may be modified as necessary to suit local circumstances and winter service plans.

H7.2 The training of decision making and management staff is important. Although there is no formal qualification currently available for Winter Service decision making and management, such staff should have a number of years' experience and have received a sufficient level of training in operational and weather forecasting methods. Authorities should also conduct periodic exercising to test plans for responding to severe weather events.

H7.3 Road Surface Wetness

For the purpose of allocating treatments a distinction is made between dry, damp and wet road surfaces. The following definitions should be used when making the treatment decision.

Table H2 - Road Surface Wetness	
Dry road	A road that shows no signs of water or dampness at the surface but may be just detectably darker (however it may have moisture contained in pores below the surface that is not 'pumped' to the surface by traffic)
Damp road	A road which is clearly dark but traffic does not generate any spray. This would be typical of a well drained road when there has been no rainfall after 6 hours before the treatment time.
Wet road	A road on which traffic produces spray but not small water droplets. This would be typical of a well drained road when there has been rainfall up to 3 hours before the treatment time.

H7.4 Traffic levels

For the purpose of allocating treatments, the guidance defines two levels of trafficking on roads – heavily trafficked roads and medium/light trafficked roads.

As shown in the table below, heavily trafficked roads are those defined as Categories 1 and 2 in Well Maintained Highways and medium/light trafficked roads are those defined as Category 3.

Table H3 – Carriageway Hierarchy		
Category	Hierarchy Description	Traffic Level
1	Motorway	Heavy
2	Strategic Route	Heavy
3a	Main Distributor	Medium/Light
3b	Secondary Distributor	Medium/Light

H7.5 Precautionary treatment decision matrix

A decision matrix for precautionary treatments based on road surface conditions and predicted weather conditions is given in Table H4.

Table H4 – Precautionary Treatment Decision Matrix				
Road Surface Temperature	Precipitation	Predicted Road Conditions		
		Wet/Damp	Wet Patches	Dry
May fall below 1°C	<u>No</u> rain <u>No</u> hoar frost <u>No</u> fog	Salt before Frost	Salt before frost (see note a)	No action likely, monitor weather (see note a)
Expected to fall below 1°C	<u>Expected</u> hoar frost <u>Expected</u> fog			
	<u>Expected</u> rain BEFORE freezing	Salt after rain stops (see note c)		
	<u>Expected</u> rain DURING freezing	Salt before frost, as required during rain and after rain stops (see note d)		
	<u>Possible</u> rain <u>Possible</u> hoar frost <u>Possible</u> fog	Salt before frost	Monitor weather conditions	
	Expected snow (See Section H10)	Salt before snow fall		
<p>The decision to undertake precautionary treatments should be, if appropriate, adjusted to take account of residual salt or surface moisture.</p> <p>All decisions should be evidence based, recorded and require continuous monitoring and review.</p>				

Notes:

- (a) Particular attention should be given to the possibility of water running across carriageways and other running surfaces e.g. off adjacent fields after heavy rains, washing off salt previously deposited. Such locations should be closely monitored and may require treating in the evening and morning and possible other occasions.
- (b) When a weather warning contains reference to expected hoar frost, considerable deposits of frost are likely to occur. Hoar frost usually occurs in the early morning and

is difficult to cater for because of the probability that any salt deposited on a dry road too soon before its onset, may be dispersed before it can become effective. Close monitoring is required under this forecast condition which should ideally be treated just as the hoar frost is forming. Such action is usually not practicable and salt may have to be deposited on a dry road prior to and as close as possible to the expected time of the condition. Hoar frost may be forecast at other times in which case the timing of salting operations should be adjusted accordingly.

- (c) If, under these conditions, rain has not ceased by early morning, crews should be called out and action initiated as rain ceases.
- (d) Under these circumstances rain will freeze on contact with running surfaces and full precautionary treatment should be provided even on dry roads. This is a most serious condition and should be monitored closely and continuously throughout the danger period.
- (e) Weather warnings are often qualified by altitudes in which case differing action may be required from each depot.
- (f) Where there is any hint of moisture being present, a pessimistic view of the forecast should be taken when considering treatment to negatively textured surfaces.

H7.6 Determining spreading capability

For precautionary treatments, the spread rates to be used depend upon the spreading capability. A decision process diagram to determine this capability is given below, and the spread rates are given in Section H8.

The decision matrix is based on the condition of the salt and the spreader performance, as well as the calibration of the spreader. The lower spread rates (given in Section H8) are used where the spreading capability is deemed to be '*reasonable*', and the higher rates are used where the capability is '*modest*'.

- **Reasonable capability**

This level of spreading capability is provided where an authority has new or reasonably good technology spreaders, the salt being spread is in good condition (because it has been stored in good condition) and there is a reasonably good level of calibration.

Low spread rates can be adopted if an authority is confident that it provides a reasonable level of spreading capability.

- **Modest capability**

This level of spreading capability is provided where an authority has old or relatively low technology spreaders, the salt has been stored in less than optimal conditions, or where an accurate calibration cannot be achieved.

Higher spread rates must be adopted for a modest level of spreading capability.

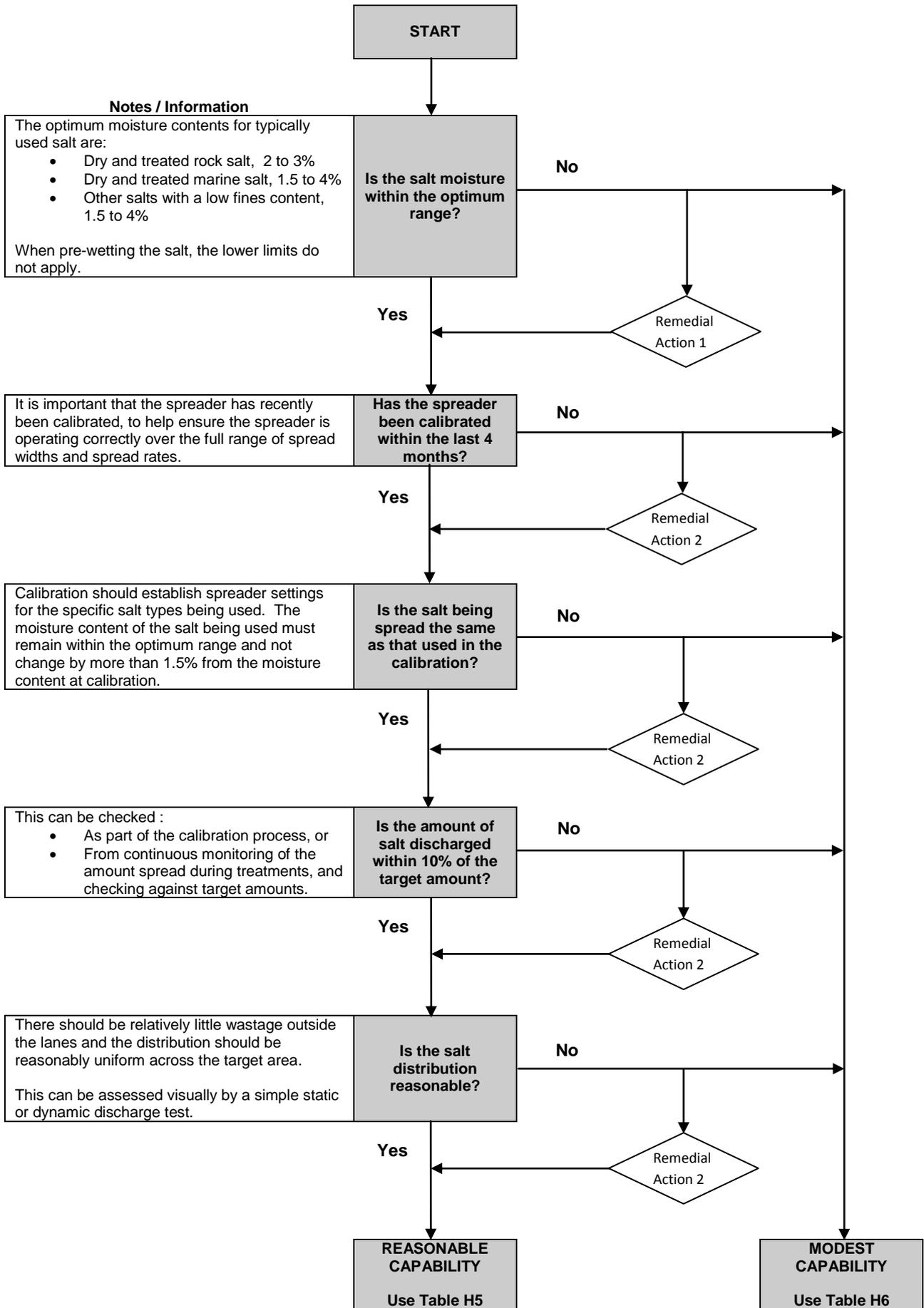
The flow chart in this section provides a simple method of determining whether the spreading capability can be considered reasonable or modest. It asks a number of

questions relating to the condition of the salt and the calibration and performance of the spreader.

- If the answer to all of the questions is 'Yes', the spreading capability is reasonable.
- If the answer to any of the questions is 'No', the spreading capability is modest.
- Where a requirement is not met, Section H7.7 gives remedial actions which, if undertaken, may allow a reasonable spreading capability to be obtained.

Once the level of spreading capability has been established, the appropriate rates are as follows:

- For a reasonable level of spreading capability, the spread rates used should be those given in Table H5
- For a modest level of spreading capability, the spread rates used should be those given in Table H6



H7.7 Remedial Actions to improve spreading capability

- **Action 1**

Mix the salt with drier or wetter salt (as appropriate to decrease or increase the moisture content). Use salt from the stockpile or from new deliveries.

A simple test for moisture can be undertaken using a standard oven and a suitable set of weighing scales. A 500g sample of UK rock salt placed in an oven at no more than 65°C until completely dry will show a weight loss of between 7.5g (if its moisture content is 1.5%) and 20g (if its moisture content is 4%).

- **Action 2**

Calibrate the spreader using the salt being spread.

4 SPREAD RATES FOR PRECAUTIONARY TREATMENTS

This section replaces the current Well Maintained Highways – Appendix H - Section H8

H8 TARGET SPREAD RATES OF SALT FOR PRECAUTIONARY TREATMENTS

H8.1 Spread rates for precautionary treatments (forecast frost conditions)

Spread rates for precautionary treatments before frost are given in Tables H5 & H6. The tables provide recommended spread rates for dry, pre-wetted and treated salting for a range of weather and road surface conditions.

Table H5 provides spread rates for a reasonable spreading capability.

Table H6 provides spread rates for a modest spreading capability.

NOTE: The following points must be considered when using the spread rate tables.

1. The given spread rates are for sections of well drained roads without ponding or runoff from adjacent areas.
2. The rates may be adjusted to take account of variations occurring along routes such as temperature, surface moisture, road alignment and traffic density.
3. The rates may be adjusted to take account of residual salt levels. However, residual salt levels will tend to be lower if lower spread rates are introduced. Residual salt levels are most likely to be significant on marginal nights after treatments on two or three successive days without precipitation in the intervening period.
4. On porous asphalt and on dense surfacing for 1km after a change from porous asphalt, spread rates should be increased by 50 per cent on roads with medium traffic levels and by 25 per cent on heavily trafficked roads.
5. Spread rates should be increased to a rate appropriate for the particular situation where negatively textured thin surfacings are poorly drained such that water can accumulate within the surface texture.
6. When the rates in Tables H5 and H6 are significantly lower than those used previously, it is recommended that the reduction should be introduced in stages and the performance of spreaders monitored. In particular, checks should be made that the amount of salt discharged is within 10 per cent of the target and that treatments are effective.
7. All decisions should be evidence based, recorded and require appropriate monitoring and review.
8. During periods of sustained freezing and provided that surfaces are well drained and there is neither seepage (from melt water) nor ice present, rates of spread for treatments carried out within six hours of previous treatments may be 50% of the rates stated in the appropriate table.

Table H5 - Spread Rates For Reasonable Spreading Capability (De-icer Spread Rates in g/m²)

Frost or forecast frost Road Surface Temperature (RST) and Road Surface Wetness	Dry salting	Pre-wetted salting (see Note 1)	Treated salting (see Note 2)
RST at or above -2°C and dry or damp road conditions	8	8 (de-icer) 6 (salt)	7
RST at or above -2°C and wet road conditions	8	8 (de-icer) 6 (salt)	7
RST below - 2°C and above -5°C and dry or damp road conditions	12	12 (de-icer) 9 (salt)	9
RST below - 2°C and above -5°C and wet road conditions	20	21 (de-icer) 16 (salt)	16
RST at or below -5°C and above -10°C and dry or damp road conditions	20	21 (de-icer) 16 (salt)	16
RST at or below -5°C and above -10°C and wet road conditions	2 x 20	2 x 21 (de-icer) 2 x 16 (salt)	32 or 2 x 16

Note 1: Spread rates for pre-wetted salting are the combined weight of dry salt and brine combined in proportion 70:30 by weight with brine of concentration 20 to 23%.

Note 2: Weight of salt and additive (approx 3% by weight).

**Table H6 - Spread Rates For Modest Spreading Capability
(De-icer Spread Rates in g/m²)**

Frost or forecast frost Road Surface Temperature (RST) and Road Surface Wetness	Dry salting	Pre-wetted salting (see Note 1)	Treated salting (see Note 2)
RST at or above -2°C and dry or damp road conditions	8	8 (de-icer) 6 (salt)	7
RST at or above -2°C and wet road conditions	11	9 (de-icer) 7 (salt)	8
RST below -2°C and above -5°C and dry or damp road conditions	15	13 (de-icer) 10 (salt)	10
RST below -2°C and above -5°C and wet road conditions	27	25 (de-icer) 19 (salt)	19
RST at or below -5°C and above -10°C and dry or damp road conditions	27	25 (de-icer) 19 (salt)	19
RST at or below -5°C and above -10°C and wet road conditions	2 x 25	2 x 24 (de-icer) 2 x 18 (salt)	36 or 2 x 18

Note 1: Spread rates for pre-wetted salting are the combined weight of dry salt and brine combined in proportion 70:30 by weight with brine of concentration 20 to 23%.

Note 2: Weight of salt and additive (approx 3% by weight).

The rates for dry salt in the three more extreme conditions shown in the above table are higher than the minimum suggested in Well Maintained Highways. It should be noted that evidence indicates that many authorities were spreading at rates far higher than the WMH minima. It is expected that all authorities should have full confidence in using the suggested new rates provided in this guidance, which have been based on recent research and evidence.

5 TREATMENTS FOR SNOW AND ICE

This section adds to the current Well Maintained Highways – Appendix H –with a new Section H10

H10 TREATMENTS FOR SNOW AND ICE

H10.1 General

- It is impractical to spread sufficient salt to melt anything other than very thin layers of snow and ice.
- Ploughing is the only economical, efficient, effective and environmentally acceptable way to deal with all but very light snow.
- Ploughing down to the road surface is preferred. However, snow ploughs should be set to avoid risk of damage to the plough, the road surface, street furniture and level crossings.
- Ploughing to the road surface minimises salt usage and makes salt treatments more effective.
- Drainage should not be obstructed when ploughing. Windrows or piles of snow should be removed or be positioned to allow melt water to reach the drains. If necessary, piles of snow should be removed so that melted snow does not overload drainage systems or run back onto the road.
- Windrows should be removed or ploughed back when further periods of heavy snow are anticipated. This will provide space to plough further snowfalls.

H10.2 Preparation before ice and snow

To prepare for and facilitate ice and snow treatments the following should be considered:

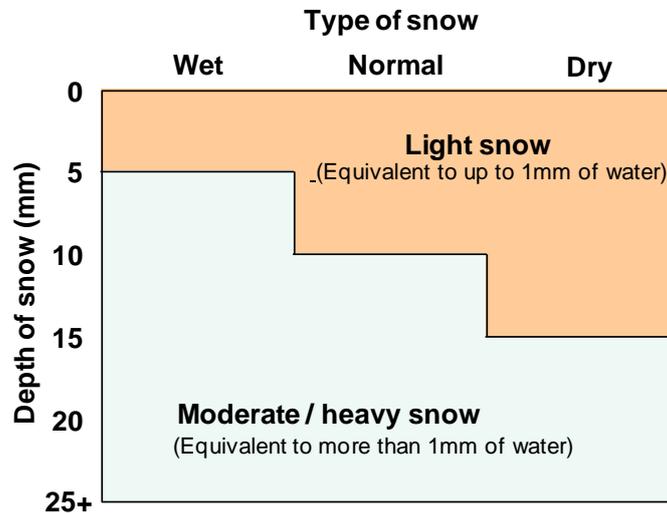
- When snow is forecast, ploughs and snow blowers should be prepared and positioned in order that snow clearance can start without delay as and when required.
- To facilitate the breakup and dispersal of ice and snow by trafficking, treatments must be made before snowfall or freezing rain so that sufficient de-icer is present on the surface to provide a debonding layer.
- Although it will increase salt usage, before snowfall and where practicable, consideration should be given to spreading salt on as much of the network as possible (i.e. beyond the normal precautionary salting network). This will provide a debonding layer and facilitate the break up and dispersal of snow by traffic in areas where subsequent treatments may not take place for some considerable time or at all.

H10.3 Depths of snow (Light snow, moderate to heavy snow)

This guidance defines two main snowfall categories – light snow and moderate/heavy snow. The reasons for this are:

The highest *practicable* spread rates are considered to be 40g/m² of dry salt. When combined with the action of traffic, this is sufficient de-icer to melt snow depths which are equivalent to 1mm of water at temperatures down to -2°C. Generally, there is approximately 1mm of water in 5mm depth of wet snow, 10mm depth of 'normal' snow and 15mm depth of dry, powdery snow.

In this guidance, 'light' snow is taken to be snow equivalent to 1mm of water (or less) while snowfalls equivalent to more than 1mm are considered to be moderate/heavy, as shown in the diagram below.



H10.4 Precautionary Treatments before snow or freezing rain

Spread rates for precautionary treatments before snow or freezing rain are given in Table H7

Table H7 - Precautionary Treatments Before Snow Or Freezing Rain		
Weather conditions	Light or medium traffic (Category 3)	Heavy traffic (Categories 1 and 2)
Light snow forecast	Spread: <ul style="list-style-type: none"> • 40g/m² of dry salt, or • 40g/m² of pre-wetted salt, or • 30g/m² of treated salt 	Spread: <ul style="list-style-type: none"> • 20g/m² of dry salt, or • 20g/m² of pre-wetted salt, or • 15g/m² of treated salt
Moderate/Heavy snow forecast	Spread: <ul style="list-style-type: none"> • 20-40g/m² of dry salt • 20-40 g/m² of pre-wetted salt • 15-30 g/m² of treated salt (see Note 1) 	Spread: <ul style="list-style-type: none"> • 40g/m² of dry salt, or • 40g/m² of pre-wetted salt, or • 30g/m² of treated salt
Freezing rain forecast	<ul style="list-style-type: none"> • 40 or 2x20g/m² of dry salt, or • 40 or 2x20g/m² of pre-wetted salt, or • 30 or 2x15g/m² of treated salt 	
Note 1: The lower rates (e.g. 20g/m ² for dry salt) can be used if the snow is likely to settle quickly, e.g. when the road surface temperature is below zero, the road surface is not wet and the snow is not wet, and/or there is little traffic after snowfall begins and settles.		

H10.5 Treatments during snowfall

General

- Ploughing should start and, where practicable, be continuous to prevent a build-up of snow.
- On heavily trafficked roads it is preferable to prevent a build-up of more than 10mm depth of snow, whereas the build-up should be no more than 50mm depth where there is a risk of compaction by traffic.

Table H8 - Treatments During Snowfall		
Plough to remove as much material as possible (e.g. slush, snow, compacted snow) (ploughing should be as near as possible to the level of the road surface)		
No ice or compacted snow on surface	Ice or compacted snow on surface (see Note 2)	
To provide a debonding layer, spread: <ul style="list-style-type: none"> • 20g/m² of dry salt, or • 18g/m² of treated salt or • 24g/m² of pre-wetted salt (See Note 1)	Is traffic likely to compact subsequent snowfall before further ploughing is possible?	
	YES	NO
	To provide a debonding layer, spread: <ul style="list-style-type: none"> • 20g/m² of dry salt, or • 18g/m² of treated salt, or • 24g/m² of pre-wetted salt (See Note 1)	No de-icer should be spread
Note 1: During and after snowfall, only the ploughed lane should be treated if other lanes have still to be ploughed. The spread width settings should be adjusted accordingly. Note 2: A de-icer should not be spread alone without abrasives to anything other than a thin layer of ice or compacted snow when snowfall has ceased or future snowfall will be less than 10mm. Applying salt alone to compacted snow and ice can produce dangerously slippery conditions if a weak brine film is formed on top of the ice/snow layer.		

H10.6 Treatment when slush is on the road (and it may refreeze)

General

- It is important to remove as much slush as possible by ploughing to reduce the amount of material available to form ice when temperatures drop, as well as to reduce the amount of salt required for subsequent treatments.

Treatment

When slush is on the road, treatments should be as follows:

Table H9 - Treatment For Slush When Freezing Conditions Are Forecast
Plough to remove as much slush as possible (ploughing should be as near as possible to the level of the road surface).
After removing slush, spread: <ul style="list-style-type: none">• 40g/m² of dry salt, or• 36g/m² of treated salt, or• 48g/m² of pre-wetted salt (See Note 1)
Note 1: After snowfall, and when there will be no further ploughing but some slush remains on the road surface, it may be necessary to change the settings normally used for precautionary treatment to ensure a satisfactory distribution is achieved over the target spread width.

H10.7 Treatment when thin layers of ice (up to 1mm) have formed

When a thin layer of ice has formed, including after freezing rain the following treatment should be made:

Table H10 - Treatment For Thin Layers Of Ice (Less Than 1mm Thick)		
Forecast weather and road surface conditions	Medium/Light Traffic	Heavy traffic
Lower of air or road surface temperature higher than -5°C	Spread: <ul style="list-style-type: none"> • 40g/m² of dry salt, or • 36g/m² of treated salt or • 48g/m² of pre-wetted salt • 40g/m² of salt/abrasive mix (see Notes 1 and 2) 	Spread: <ul style="list-style-type: none"> • 20g/m² of dry salt, or • 18g/m² of treated salt or • 24g/m² of pre-wetted salt
Lower of air or road surface temperature less than -5°C	Spread: <ul style="list-style-type: none"> • 40g/m² of salt/abrasive mix (50:50) (see Notes 1 and 2) 	Spread: <ul style="list-style-type: none"> • 40g/m² of salt/abrasive mix (50:50) (see Notes 1 and 2)
<p>Note 1: Abrasives should ideally be 5-6mm and angular, but gradings down to 1-5mm should be reasonably effective. After abrasives have been used, drainage systems should be checked and cleared if necessary. Recovered material, which will be contaminated with road oil, must be disposed of safely.</p> <p>Note 2: Care is needed when salt is mixed with abrasives with a high moisture content. Checks should be made that the mixture remains free flowing, does not clump and can be spread effectively.</p>		

H10.8 Treatment for thicker layers of ice or compacted snow

When thicker layers of ice have formed, including after freezing rain, the treatment should be as follows:

Table H11 - Treatment For Layers Of Compacted Snow And Ice	
Plough to remove as much material (e.g. slush, snow, compacted snow) as possible from the top of the compacted layer	
Medium Layer Thickness (1 to 5 mm)	High Layer Thickness (greater than 5mm)
<p>For initial treatment, spread:</p> <ul style="list-style-type: none"> • 40g/m² of salt/abrasive mix (50:50) (see Notes 1, 3, 4 and 5) <p>For successive treatments, spread:</p> <ul style="list-style-type: none"> • 20g/m² of salt/abrasive mix (50:50) (see Notes 1, 3, 4 and 5) 	<p>For initial treatment, spread:</p> <ul style="list-style-type: none"> • 40g/m² of abrasives only (see Notes 2, 3, 5 and 6) <p>For successive treatments, spread:</p> <ul style="list-style-type: none"> • 20g/m² of abrasives only (see Notes 2, 3, 5 and 6) <p>After traffic has started breaking up the layer, spread:</p> <ul style="list-style-type: none"> • 20g/m² of salt/abrasive mix (50:50) so salt can penetrate the layer and reach the road surface (see Notes 1, 3, 4 and 5)
<p>Note 1: For medium thicknesses of compacted snow and ice, treatments without abrasives should only be used when earlier precautionary treatments have successfully established a debonding layer, and there is sufficient traffic to break up the layer of ice quickly.</p> <p>Note 2: For high thickness of compacted snow and ice (greater than 5mm), treatments with a significant amount of salt should not be considered because they may leave the surface uneven. Any brine formed on the surface may collect in hollows and deepen them further, which can lead to a very uneven surface.</p> <p>Note 3: Abrasives should ideally be 5-6mm and angular, but gradings down to 1-5mm should be reasonably effective. After abrasives have been used, drainage systems should be checked and cleared if necessary. Recovered material, which will be contaminated with road oil, must be disposed of safely.</p> <p>Note 4: Care is needed when salt is mixed with abrasives with a high moisture content. Checks should be made that the mixture remains free flowing, does not clump and can be spread effectively.</p> <p>Note 5: When there are layers of snow, compacted snow, or ice of medium or high thickness on the road surface, it may be necessary to change the settings normally used for precautionary treatment to ensure a satisfactory distribution is achieved over the target spread width.</p>	

Note 6: A small amount of salt should be added to the abrasive to prevent freezing of the water within it. If the moisture content of the abrasive is 7%, 25g of salt per tonne of abrasive is sufficient to prevent freezing if thoroughly mixed.

6 REFERENCES

Well-maintained Highways: The Code of Practice for Highway Maintenance Management. UK Roads Liaison Group

Both the original edition of the Code and the Complementary Guidance are available from
www.ukroadsliasongroup.org/roads/code_of_practice.htm.

Winter Service Guidance for Local Authority Practitioners

www.ukroadsliasongroup.org/roads/code_of_practice.htm.

Highways Agency Network Management Manual

http://www.standardsforhighways.co.uk/nmm_rwsc/index.htm

The NSSRG (NWSRG) Best Practice Guidance for Spreading Salt (2005)

www.trl.co.uk/nwsrg

The NWSRG Practical Guide for Winter Service

www.trl.co.uk/nwsrg