Transport for London

Guidance on the use of Footway Gritting Equipment and Treatment Regimes

October 2010

Halcrow Group Limited

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1 Executive Summary

During the winters of 2008/09 and 2009/10, London and the rest of the UK experienced severe winter weather, resulting in widespread disruption to travel across much of the capital. Due to the severity and widespread nature of weather events, salt suppliers were unable to meet demand. The treatment of footways became an operational issue in light of the shortage of salt. Post-season reflection highlighted the requirement for effective ways of treating footways with the appropriate equipment and treatment dosages.

Footway spreaders can be categorised as the following:

- manual spreaders;
- towed spreaders; and
- mini-spreaders.

The suitability of each type of footway spreader used will be determined by factors unique to each authority. Typically, a suitable footway spreader can be chosen through consideration of the following factors:

- the number of footways to treat;
- length of treatment routes; and
- localised conditions such as incline, surface type, footway width, the amount of street furniture on the footway.

Capital costs vary considerably, from £120 to over £35,000 and with annual operational costs being several thousand pounds per plant, the decision process regarding which type of equipment to purchase is important and should be taken with due consideration of a number of factors.

A number of equipment types have been researched and are documented in Appendix E. Should London authorities wish to consider purchasing any of the equipment listed, it is recommended that a business case be produced, obtaining more accurate costs from suppliers, for the quantities required. The business case would look to cover all procurement routes open to London highway authorities for the provision of footway de-icing equipment, as well as providing an accurate picture of the benefits likely to be realised from different options. A review of

footway de-icing equipment and its capabilities has been carried out and is summarised below for reference

	Manual Spreaders	Towed Spreaders	Mini-spreaders
Capital Cost	LOW	HIGH	HIGH
Operational costs	MEDIUM	LOW	HIGH
Typical ability (using example from Appendix D) to treat various footway lengths without need for refilling (based on 1.8m wide footway; 10g/m^2)			
1km footway	YES	YES	YES
2km footway	YES	YES	YES
3km footway	NO	YES	YES
5km footway	NO	NO	YES
10km footway	NO	NO	YES
Typical ability (using example from Appendix D) to treat various footway lengths without need for refilling (based on 4.0m wide footway; 10g/m2)			
1km footway	YES	YES	YES
2km footway	NO	NO	YES
3km footway	NO	NO	YES
5km footway	NO	NO	YES
10km footway	NO	NO	YES
Ability to operate under various pedestrian traffic levels*			
High levels	NO	NO	NO
Low levels	YES	YES	YES
Material types available to spread**			
Dry salt	YES	YES	YES
Brine only	YES	YES	YES
Pre-wetted salt	NO	NO	YES
Operational support levels required for refilling	HIGH	MEDIUM	LOW
Ability to operate in areas of dense street furniture	HIGH	LOW	MEDIUM
*The level of risk associated with operating under high levels of pedestrian traffic should be assessed by each authority			
**Specialist equipment required to be procured for brine-only and pre-wetted treatment			

Manually operated spreaders are the most basic form of mechanical spreading and are widely available. Although basic, manual spreaders provide significant improvement on accuracy and efficiency characteristics of footway de-icing when compared to shovelling salt by hand.

They are best suited for the treatment of smaller areas of footway as they are labour intensive and need refilling relatively often. They are portable and highly manoeuvrable and thus suited to treating footway areas which have dense street furniture or multiple obstructions. They have a limited range but this can be extended by restocking from salt bins or providing a support vehicle. They are significantly slower than towed or mini spreaders.

The cost for operating a typical manual spreader is approximately £2,200-£2,400 over the course of a season.

Manual Spreader performance

	Spread rate: 10g/m2	Spread rate: 20g/m2
Capacity: 50kg	2.78km	1.39km
Time: 50kg	1.39hr	0.70hr

Appendix C sets out the assumptions made for the above performance calculation

Towed de-icing plant is typically larger in size than manual spreading plant. Each piece of equipment requires a towing vehicle, which can include quad bikes, tractors, 4x4s and vans of varying sizes. Due to their increased size and treatment speed, compared with manual spreaders, towed spreaders are suitable for the treatment of larger areas/lengths of footway. However, they have reduced manoeuvrability when compared with manual spreaders and are less suitable in treating areas of footway densely populated by street furniture.

The limitation on the manoeuvrability of towed spreaders is likely to be determined by the towing vehicle. Quad bikes will be able access more areas and will have the greatest manoeuvrability. Towed spreaders could either be refilled by a supporting van on the street or at the depot, depending on the size of hopper used. Footways which are long and linear in shape would be ideally suited to treatment by towed spreader.

Section 300 of the 1980 Highways Act states that 'the use of mechanical vehicles in pedestrian areas for the purposes of maintenance is permitted and highway de-icing falls within this category'. Section 4 of the Vehicle (Considerations of Use

on Foortways) Regulations provides weight and speed limitations, as set out in Appendix A .The prices for the 'mid range' towable equipment start at around £1,000 but for completeness, the price of the towing vehicle should be factored into the capital cost of towed spreading equipment. A 500cc quad bike is the most economic of the towing equipment and has an additional size and flexibility advantage over larger towing vehicles. The operational costs of towed vehicles are significantly lower than manually operated equipment.

Towed Spreader performance

	Spread rate: 10g/m2	Spread rate: 20g/m2
Capacity: 60kg	3.34km	1.67km
Time: 60kg	0.44hr	0.22hr
Capacity: 600kg	33.44km	16.7km
Time: 600kg	4.46hr	2.23hr

Appendix C sets out the assumptions made for the above performance calculation

Mini-spreaders are purpose-built, self-powered footway de-icing plant. Vehicle-mounted spreaders are large-capacity hoppers with spreading equipment which can be mounted onto the back of tractors. The capacities of mini-spreaders and vehicle mounted spreaders are much larger than that of towed or manually operated equipment, resulting in the ability to treat much greater areas of footway before the need to refill arises.

Mini-spreaders are similar in size to mini-sweepers and as such, these vehicles should be suitable for use wherever mini-sweepers are currently operated. Additionally, greater manoeuvrability over towed plant means that mini-spreaders can operate in more restricted spaces as well as on larger areas or longer routes. Vehicle mounted spreaders are less operationally flexible than mini-spreaders due to being transported using tractors. This means that their usage will be limited to only the most open, obstruction-free footway areas.

Operationally, both mini-spreaders and vehicle-mounted spreaders are typically refilled at the depot due to their considerable capacity. This means that both types of spreader require no support vehicles and can operate independently. They are ideal for treatment across long distances.

Mini-spreaders are the most expensive footway treatment plant on the market and difficult to quantify in terms of the costs for a single unit. Operational costs for the

'mini-spreader' category are the highest of any spreader type, with annual running costs being calculated at £3,900.

A consideration for plant type is the type of de-iceant to be used. The recommended precautionary treatment for footways would be brine, as this method allows for accelerated de-icing effect when compared with dry-salt and requires no footfall for activation. Brine and pre-wetted treatments are not as effective for lying snow. Instead the recommended method of treatment would be the use of dry salt, possibly alongside an abrasive such as sand.

Mini-spreaders/vehicle mounted spreaders performance

	Spread rate: 10g/m2	Spread rate: 20g/m2
To	Capacity: 250kg	13.88km	6.94km
	Time: 250kg	1.85hr	0.93hr
da	Capacity: 600kg	33.44km	16.7km
	Time: 600kg	4.46hr	2.23hr

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Appendix C sets out the assumptions made for the above performance calculation

To date, the general practice for treating footways varies not only in London but across the country. As an industry, there is limited documentation surrounding the treatment of footways and this report has attempted to draw together specific industry-wide best practice and best knowledge in the production of the guidance herein. Should LoTAG wish to enhance the guidance in this note through the pursuit of more detailed knowledge of footway treatment dosages, it is recommended further research through an industry research group such as the National Winter Research Group (NWSRG) should be sought.

2 Introduction and Scope

The winter seasons of 2008/09 and 2009/10 challenged the resilience of local highways authorities' networks with snowfall, low humidity conditions and prolonged sub zero temperatures being experienced across the UK. As a result of these extreme weather conditions, the importance of highway authorities being able to treat their networks accurately and efficiently has become an important objective.

Transport for London (TfL), the 32 London boroughs and the City of London (hereafter collectively referred to as the London authorities) provide winter service for the roads of Greater London, consisting of snow removal and precautionary treatments using salt.

The stated aim of the task is specifically to: provide guidance on the various methods and techniques for undertaking footway treatments. Each option identified in the report shall, as a minimum, detail the benefits, operational issues (route lengths, material effectiveness etc.) and capital / operational costs. The report shall also seek to provide guidance on dosages of anti-icing /de-icing agents through these techniques and other means of maintaining the footway in a safe condition.

This guidance note will consider current recommendations from Section 13 of Well Maintained Highways (2009), before reviewing several examples of winter service arrangements for footway treatment currently undertaken by the London authorities. Following this will be a review of equipment available for carrying out footway treatments, listing individual advantages and disadvantages, costs, and the practicalities of each type. Salt dosages and salt type shall also be discussed.

Note - this will be an options study and will not make specific recommendations for London. Subject to the findings of this study, additional work may be required to make specific recommendations for London's footways.

Winter Service Provision

The structure for providing winter service effectively is a two-part delivery. The first part considers policy and the second part would covers operations. It should

be noted that policy falls outside of the scope of this document, but reference to policy has been added for completeness.

Policy

The guiding principles for undertaking winter service which follow have been taken from Well Maintained Highways (2009):

Authorities should formally approve and adopt policies and priorities for Winter Service, which are coherent with wider objectives for transport, integration, accessibility and network management, including strategies for public transport, walking and cycling. They should also take into account the wider strategic objectives of the authority.

Policy includes some of the following documents and legislation:

- Codes of practice, including Well Maintained Highways (2009)

  Section 13 of Well Maintained Highways (2009), offers guidance to highway authorities with respect to winter service. The applicable details of this are set out in Appendix A.

- Legislation, including the Highways Act (1980), Vehicle Regulations (1963)

  Section 41 of the 1980 Highways Act states that highway authorities have a duty to ensure that public highways under their jurisdiction are kept free of snow and ice. The applicable details of this are set out in Appendix A.

- Section 4 of the Vehicles (Conditions of Use on Footpaths) Regulations 1963. SI 1963 2126 makes reference to limitations on vehicle size and speed when on the footway. These include:
  - Weight - 1 ton maximum
  - Speed – 5mph
  - The applicable details of this are set out in Appendix A.

Treatment Prioritisation

Authorities are therefore required to define treatment route plans for carriageways, cycle routes and footways for pre-treatment and snow conditions, based upon the

general maintenance hierarchy and adapted to take into account the factors identified by their policy.

Footways themselves are often given their own hierarchy in terms of treatment prioritisation. For example, commuter routes, town centre areas of heavy footfall and sections of footway surrounding hospitals and surgeries tend to be treated with a higher priority than footways which are seldom used and those on the periphery of major urban areas. See Appendix A for further details.

This hierarchy is designed primarily for precautionary treatment, under 'normal working conditions'. During periods of severe weather, prolonged sub zero conditions, continuous snow fall etc, would trigger a second hierarchy under a revised priority or in line with the resilience networks, which is focussed on a more limited selection of footways to be treated.

London Resilience Footways

The definition for areas to be considered as Resilience Footways in London has been developed as part of the Winter Services Review. Resilience Footways describes the minimum footway areas within the GLA boundary to be treated during winter service operations so that core essential services can operate. The footway resilience areas are designated by the Highway Authority.

The resilience areas should include locations which have either exceptionally high usage or are primary pedestrian routes, providing access to key services. Detailed definition of London's Resilience Footways is set out within Appendix A

3 Examples of Current Practice in London

The following hierarchy is common throughout the London authorities (including the responsibilities of TfL) with regard to de-icing. Treatment decisions vary from precautionary prioritised procedures to reactive procedures and are dependent on the severity of weather conditions.

1. Very busy locations around public transport interchanges and busy pedestrian areas
2. Residential and shopping frontages
3. Moderately used footways
4. Seldom used footways.

As part of this study, each London authority was contacted and asked to provide information on their winter policies on footway treatments. The questions asked of them were as follows:

1. How are footways prioritised within an authority?
2. What precautionary treatments are carried out on footways?
3. What reactive treatments are carried out following snowfall or a very rapid frost?
4. What equipment is used to carry out the treatments?
5. Which spread rates are used when carrying out the treatments?

Full details of the responses received from twelve London Boroughs are set out in Appendix B.

The feedback received demonstrates that there is a varied approach in the policy for treating footways between the London authorities. However, the methods and hierarchy employed are similar in many cases. Practices differ in that some Boroughs carry out precautionary and/or reactive treatments and others carry out only solely reactive treatments. Both practices use either manual or mechanical means to treat.

As set out in paragraph 13.2.4 of Well Maintained Highways (2009), it is rarely possible to ensure that each section of network is kept free of snow and ice at all

times. Those sections that are able to be treated are done so 'as far as is reasonably practicable'.

However, in consideration of the feedback received, it is considered that a policy of formal treatment regimes could be adopted on a London-wide basis. These should be set out in the Winter Service Plans and publicised for the public to view and understand.

4 Equipment available and capabilities

4.1 *Overview*

There are three main types of equipment available for the precautionary and de-icing treatment of footways:

- manually operated (or in some instances powered by a small motor and pushed);
- towed equipment; and
- mini-spreaders.

These three types of equipment are discussed in detail in Sections 4.1 to 4.3 which follow. Each discussion covers the operational advantages and disadvantages of each type of equipment with likely costs associated with the plant also being considered. The treatment capacity for each equipment type is shown in appendix C. It should be noted that the determination of operational costs is inherently subjective and requires numerous assumptions (see Appendix D for more details). Individual capital costs for the various types of equipment researched are included in Appendix E. With regard to capital cost of the plant featured, prices are driven heavily by economies of scale. As such, this presents an excellent opportunity for joint procurement procedures to be undertaken by London highway authorities as a cost saving measure, assuming it is cost-effective to replace existing plant. For this reason, it is important to acknowledge that some of the prices listed in Appendix E are indicative, particularly those associated with the larger mechanical types of equipment.

This is due to the following reasons:

- Various options and add-ons tend to be available, which makes the provision of an accurate quote difficult, as a bespoke specification is required by the supplier.
- The type of market means that some manufacturers operate mainly through a tender process and prices are difficult to attain simply for the purposes of an options paper.

However, Halcrow's experience in assisting the Highways Agency to procure its new winter service fleet has enabled a confident estimate to be given on certain pieces of equipment.

Appendix D sets out an example of running costs for the three types of equipment discussed within this paper, (manual, towed and mini-spreaders), for a dosage of 10g/m² and 20g/m². A nominal length and width of footpath has been used to provide consistency with Appendix C, which considers treatable length of footway for three different pieces of equipment.

The type of equipment suitable for purchase by a particular London highway authority will depend on a number of factors including:

- the number of footways to treat;
- length of treatment routes; and
- localised conditions such as incline, surface type, footway width, the amount of street furniture on the footway.

4.2 Manually Operated Spreaders

Manually operated spreaders are the most basic form of mechanical spreading available. Generally, the spreader consists of a hopper and spreading mechanism mounted on a portable frame which can be hand pushed by an operative. These spreaders are widely available and can be procured from a variety of suppliers (see Appendix E for more details). Although basic, manual spreaders provide significant improvement on accuracy and efficiency characteristics of footway de-icing when compared to shovelling salt by hand.

Appendix E shows the range of manual spreaders available on the market together with their specifications, including treatable lengths. It can be seen that over 2.7km of footway treatment is achievable from a manual/push type device (based on the treatment of a 1.8m wide footway using a spread rate of 10g/m², (see Appendix C for further detail). However, longer treatment capabilities should be balanced against the risk associated with pushing a heavy device in snowy conditions. Additionally, it should be noted that manual brine-only spreaders can also be purchased. Guidance regarding alternative material types can be found in Section 5.

Manual spreaders vary from 0.45 to 0.75m in physical width and have spread widths of 1 to 8m. Consequently, they are best suited for the treatment of smaller

areas of footway as they are labour intensive and need refilling relatively often. Their lightness and compact size make them very portable and operationally flexible. As they are highly manoeuvrable, they are suited to treating footway areas which have dense street furniture or multiple obstructions.

Due to their limited range, however, careful consideration needs to be given to the deployment of manually operated spreaders when de-icing footways. If salt bins have been strategically positioned, suitable treatment routes can be planned around these. If this methodology is to be used, the location and maintenance of bins should be considered within costing calculations, when purchasing the desired plant.

Since the positioning of salt bins is not likely to coincide precisely with treatment routes, it is probable that a support vehicle carrying salt would need to be on hand for refilling. In this respect, manual spreaders are ideal for assignment along with a pick-up type vehicle for the treatment of a number of footway routes or areas. In any case, vehicles need to be in place to transport between the depot and where treatment is required. Due to the requirement of a support vehicle for refilling, only footways situated within easy access of a road suitable for the van to be positioned on, could be readily treated. Footway areas situated far from such access points would not be suitable for treatment by manually operated spreaders.

The capital costs of hand pushed equipment start at around £125.00 for R E Daniel "EV-N spreader, with the most expensive hand pushed kit costing in the region of £1,000.00 from Glasdon, a larger capacity spreader with flexible material choice and adjustable spread width.

From Appendix D, it can be seen that the cost for operating a typical manual spreader is approximately £2,200-£2,400 over the course of a season, given the defined assumptions. The bulk of each cost is made up of the operative's time and the time of the driver transporting the operative. For the purposes of this calculation, it has been assumed that the driver will drive two operatives to their treatment locations, thereby halving costs accrued through the use of transport.

- capital cost varies from: £125 to £1,000
- estimate of Running Cost at 10g/m²: £2,266.5
- estimate of Running Cost at 20g/m²: £2,347.50

Although the manually operated equipment is the most economical type to purchase and maintain, the length of time taken to complete the treatment is significantly longer when compared that of the towed and mini-spreaders. There is also a requirement to transport the spreaders to treatment locations. Thus the labour cost for operatives is higher than that associated with towed spreaders or mini-spreaders.

Appendix C sets out treatment calculations for one example of a 50kg manual spreader. These cover both 10 and 20g/.m2 spread rates and this example provides treatable lengths of 2.78 and 1.39km accordingly. This is based on a 2kph manual speed. Appendix C sets out the assumptions made for the performance calculation below.

Manual Spreader performance

	Spread rate: 10g/m2	Spread rate: 20g/m2
Capacity: 50kg	2.78km	1.39km
Time: 50kg	1.39hr	0.70hr

Table 4.1: Manual Spreader Summary Table

Capital Cost	£125 to £1,000 (see Appendix E)
Operational Costs	£2,400 (see Appendix D)
Equipment Width	0.45 – 07.5m
Spread Width	1 – 8m
Treatable length (App C)	0.8 – 3.33km
Speed	At walking speed, 2kph
Typically used for	• Short treatment routes • Treatable areas with dense street furniture • Treatable areas with very narrow access • Treatment of multiple discreet areas ('hot-spots') on the same route (i.e. hospitals, schools)
Advantages	• Lower operational costs than mini-spreader • Lowest capital costs • Low maintenance • Highly manoeuvrable • Simplistic design – limited training required • More accurate spread distribution than shovelling

Limitations	• Requires a support vehicle for refilling • Low capacity means refilling will have to be carried out more often • Requires transporting to/from treatment location

4.3 Towed Spreaders

Towed de-icing plant is typically larger in size than manual spreading plant. The spreading mechanism can either be motor driven or a simple mechanical arrangement. Each piece of equipment requires a towing vehicle, which can include quad bikes, tractors, 4x4s and vans of varying sizes. As with manual spreaders, towed brine spreaders can be purchased as an alternative to dry salt spreaders.

Due to their increased size and treatment speed over manual spreaders, towed spreaders are suitable for the treatment of larger areas/lengths of footway, with treatable lengths ranging from 11-53km (based on 1.8m width footway at 10g/m^2) and up to 133kms is achievable at reduced rates for the very largest towed spreader However, because of this increased size and the inherent reduced manoeuvrability when compared with manual spreaders, towed spreaders are less suitable in treating areas of footway densely populated by street furniture. Equipment widths vary from 1.0 – 1.22m, with spread rates varying from 1 – 3m. Indeed, the equipment itself may often be too large or wide to treat the footways in question. The limitation on the manoeuvrability of towed spreaders is likely to be determined by the towing vehicle. Quad bikes will be able access more areas and will have increased manoeuvrability over a vehicle such as a van, tractor or 4x4. However, the advantages of using one of the latter as a towing vehicle is the flexibility afforded by the fact these vehicles could be used for a range of applications year-round.

Towed spreaders could either be refilled by a supporting van on the street or at the depot, depending on the size of hopper used. A spreader such as the 'Bunce Epoke EpoMini 20' has a hopper capacity of 200kg and could easily be refilled by support vehicle, while a 'Romaquip Mini' with a hopper size of 2,400kg would be best filled by loading shovel at the operational depot. Due to the motorised nature of towed spreaders, treatment can occur at a higher speed than manual spreading. This means footways which are long and linear in shape would be ideally suited to treatment by towed spreader, as would footways that are large distances away from a suitable access road.

One aspect of using towed spreaders on footways relates to the legality of using motorised equipment in pedestrianised areas. Section 300 of the 1980 Highways Act states that the use of such vehicles, for the purposes of maintenance, is permitted; as highway de-icing falls within this category, the use of towed spreader and mini-spreaders is legal. See Appendix A for more details.

The prices for the 'mid range' towable equipment start at around £1,000 (approximately) for the "Everest" available from BSS International up to and above £35,000 for equipment from companies such as Schmidt. The larger mechanical equipment clearly has numerous advantages over the smaller towed and manually operated kit by having a more accurate spread rate, the ability to spread different de-icer types and a larger carrying capacity.

For completeness, the price of the towing vehicle must be factored into the capital cost of towed spreading equipment as it cannot be assumed that the Local Authority will have suitable vehicles on hand whenever footway de-icing treatment needs to take place. Table 4.2 shows typical towing capacities and price ranges for a variety of vehicle types.

Table 4.2: Towing vehicles and their likely costs

Vehicle Type	Max. Towing Capacity (kg)	Price Range (new) (£)
Quad Bikes:		
250cc	215	3,000-4,000
500cc	750	6,000-7,000
700cc	1,212	7,500-8,500
Tractors:		
22.4/30 kw/hp	1,380	7,500-15,000
37.3/50 kw/hp	2,500	10,000-20,000
63/86 kw/hp	5,000	20,000-30,000
4x4		
3000cc	2,250	17,000-24,000
Vans		
Small (1800cc)	800	10,000-15,000
Medium (150 bhp)	2,000	12,000-18,000
Large (250 bhp)	3,200	17,000-20,000

The most suitable towing vehicle from Table 4.2 will vary dependent on the mass of the spreader being towed. However, only one of the spreaders featured in Appendix E exceeds the towing capacity of a 500cc quad bike, making this type of vehicle the most economic of the towing equipment. An additional advantage in using a 500cc quad bike is the flexibility afforded by its small size, small turning circle and ability to access areas too narrow for tractors, 4x4 vehicles and vans.

In terms of operational costs, the most economical type of equipment is defined in Appendix D as towed equipment. Taking an average of twenty minutes to complete a route of 5000 m², the operator costs are significantly less, compared with manually operated equipment.

- capital cost of towed spreader £1,000 to £35,000
- capital cost of towing vehicle £6,000 to £7,000 (based on 500cc quad bike, capable of towing most of the featured towed spreaders in Appendix E)
- estimate of Running Cost at 10g/ m²: £1,077.00
- estimate of Running Cost at 20g/ m²: £1,153.50

Towing should utilise existing fleet vehicles wherever possible to reduce capital spend and bring efficiencies. However, it is conceivable that purchasing a dedicated 4x4 vehicle to run alongside a towed spreader could still prove to be a cheaper option than procuring a mini-spreader.

Appendix C sets out treatment length calculations for two examples of a towed spreader, rated at 60kg and 600kg. These cover both 10 and 20g/.m2 spread rates. This is based on a speed of 7.5kph. Appendix C sets out the assumptions made for the performance calculation below.

Towed Spreader performance

	Spread rate: 10g/m2	Spread rate: 20g/m2
Capacity: 60kg	3.34km	1.67km
Time: 60kg	0.44hr	0.22hr
Capacity: 600kg	33.44km	16.7km
Time: 600kg	4.46hr	2.23hr

Table 4.3: Towed Spreader Summary Table

Capital Cost of Spreader	£1,000 to £35,000 (see Appendix E)
Capital Cost of Towing Vehicle	£6,000 to £7,000 (based on 500cc quad bike, see Table 4.2)
Equipment Width	1 – 1.82m
Spread Width	1.2 – 6m
Treatable length (App C)	11 – 133km
Speed	7.5kph
Operational Costs	£1,150 (see Appendix D)
Typically used for	• Medium to long treatment routes with minimal street furniture or obstructions. • Treatable areas a long distance from points of access • Large treatable areas with access too narrow for mini-spreaders
Advantages	• Lower capital costs than mini-spreaders • Lower operational costs than manual spreading • Operated by one operative, without the requirement for a supporting vehicle in some cases • Some models are small enough to be refilled on the street • Accurate spread distribution • High capacity means less refilling required
Limitations	• Reduced manoeuvrability compared to manual spreaders and mini-spreaders – limited use in areas with dense street furniture • Some models too large to refill from a supporting vehicle • May be too wide/large to treat some footways • Requires a towing vehicle

4.4 Mini-spreaders/vehicle mounted spreaders

Mini-spreaders are purpose-built, self-powered footway de-icing plant. Vehicle-mounted spreaders are large-capacity hoppers with spreading equipment which can be mounted onto the back of tractors. The capacity of mini-spreaders and vehicle mounted spreaders is much larger than that of towed or manually operated equipment, resulting in the ability to treat much greater areas of footway before the need to refill arises. Due to their size and treatment speed over manual spreaders and towed spreaders, these are more suitable for the treatment of larger areas/lengths of footway. Treatable lengths ranging from 11-53km (based on 1.8m width footway at 10g/m^2) up to 133kms is achievable at reduced rates for the very largest towed spreader. As with towed plant, treatment times for mini-spreaders and vehicle mounted spreaders are greatly reduced compared with those associated with manual spreaders.

Capacities vary from 420 – 2160kg. Consequently mini-spreaders are similar in size to mini-sweepers and as such, these vehicles should be suitable for use wherever mini-sweepers are currently operated. Additionally, greater manoeuvrability over towed plant means that mini-spreaders can operate in more restricted spaces as well as on larger areas or longer routes. Vehicle mounted spreaders are less operationally flexible than mini-spreaders, as they are transported using tractors. This means that their usage will be limited to only the most open, obstruction-free footway areas.

These types predominately spread dry rock salt with the Schmidt Stratos being able to spread both, liquid, pre-wet and dry. Speed should be in line with current regulations – 8kph.

Appendix C sets out treatment length calculations for two examples of a powered (small) spreader rated at 250kg and a demountable 600kg (large). These cover both 10 and 20g/m² spread rates. This is based on a speed of 7.5kph. Appendix C sets out the assumptions made for the performance calculation below.

Mini-spreaders/vehicle mounted spreaders performance

	Spread rate: 10g/m2	Spread rate: 20g/m2
O Capacity: 250kg	13.88km	6.94km
p Time: 250kg	1.85hr	0.93hr
e		
r Capacity: 600kg	33.44km	16.7km
Time: 600kg	4.46hr	2.23hr

O

Operationally, both mini-spreaders and vehicle-mounted spreaders are typically refilled at the depot due to their considerable capacity. This means that both types of spreader require no support vehicles and can operate independently. The speed of the vehicles makes treatment across long distances ideal and the large hopper capacity means that more remote areas with little access can be treated without the need to spend time refilling. This solution may be ideal if cross-borough partnerships were developed.

Although mini-spreaders tend to have a much higher carrying capacity than the smaller towed and hand operated equipment, they are the most expensive footway treatment plant on the market and are difficult to quantify in terms of the costs for

a single unit. The costs set out in Appendix E have been determined from Halcrow's experience in procuring spreaders and may not represent true prices for reasons stated earlier in this note. Typically, the examples given require various decisions to be taken on the exact specification required and as such price can vary significantly.

From Appendix D, operational costs for the 'mini-spreader' category are the highest for any spreader type. Here, the introduction of much higher annual maintenance cost raises the running costs to around £3,900. At this level of maintenance expenditure, the difference between 10 and 20g/ m² is negligible.

- capital cost varies from: £12,000 to £35,000
- estimate of Running Cost at 10g/ m² £3,826.00
- estimate of Running Cost at 20g/ m² £3,897.00

Some of the higher-priced mechanical equipment has alternate capabilities in addition to being solely used to treat footways during winter. The Romaquip Mini demountable spreader body, for example, can be removed during the summer months. Authorities may therefore consider fixing a standard body for the purposes of carrying equipment, for instance, with grass cutting capabilities. This would save running costs in terms of procuring additional equipment for the purpose of grass cutting, for example.

Maintenance costs of the equipment are high, although these are likely to be minimal during the first few years dependent on warranty. The larger mini-spreaders present the highest operational costs at £3,852.50 per season, but a worthwhile task would be to investigate average maintenance and servicing costs once the equipments warranty has expired. (Maintenance costs will be limited during warranty periods).

Table 4.4: Mini-spreaders Summary Table

Capital Cost	£5,000 to £35,000 (see Appendix E)
Operational Costs	£3,900 (see Appendix D)
Equipment Width	1.45 – 1.98m
Spread Width	2 – 6m
Treatable length (App C)	23 – 133km
Speed	7.5kph
Typically used for	• Long treatment routes with minimal street furniture or obstructions. • Treatable areas a long distance from points of access
Advantages	• More manoeuvrable than towed spreaders • Operated by one operative without the requirement for a supporting vehicle • Pre-wetted treatment available on selected models • Highly accurate spread distribution • High capacity means less refilling required • Multiple uses for selected spreader models (i.e. demountable bodies)
Limitations	• Reduced manoeuvrability compared to manual spreader – limited use in areas with dense street furniture • Generally too large to refill from a supporting vehicle • May be too wide/large to treat some footways • High capital and operational costs

5 Dosages and Materials

5.1 *Dosages*

Winter Service Plans and policies typically contain a treatment matrix for treating the highway. The matrices include information such as the timings of treatments and required dosages. Having assessed the feedback from the London Authorities, the typical salt dosage rate used for a pre-treatment of a footway ranges between 10g/m² and 40g/m² depending on the equipment being used, the weather conditions, the terrain which is being treated and other localised features. An example of dosages from London Borough of Barnet suggests that their priority 1 routes are treated at 10g/m². During snow conditions it will be necessary to increase the spread rate up to a possible maximum of 40g/m². As well as treating snow with salt, there will also be numerous instances, particularly on priority 1 footway sections whereby the snow is cleared either manually, or mechanically. This will of course be dependent on localised conditions and the availability of operatives to carry out the clearance.

Section 4 and Appendix E describe the various types of equipment that can be used to treat footways. In terms of the dosage capabilities and accuracy of the spread pattern of the various types of equipment, a mechanical method of treatment rather than that of a manual treatment would provide a more controlled distribution of salt.

5.2 *Materials*

At present, the London Authorities commonly treat their footways with dry salt, with a few exceptions. However, alternative de-icers often prove to be more effective than dry salt. This section discusses the alternatives and their operational considerations in detail.

Pre-wetted

Pre-wetted salt is a de-icing technique whereby dry salt particles are coated in a layer of brine in the application process. Research on carriageway spreading has shown that that pre-wetted salt is more effective in the precautionary treatments due to the fact that the salt forms a solution far more rapidly than that of dry salt due to it already being 'wetted', and it is the solution that prohibits the formation of ice. Pre-wetted salt however, is not suited for reactive treatments on snow and

compacted ice. A more 'abrasive' de-icer such as dry salt has much more effect, along with clearance through ploughing.

Pre-wetted salt requires the production of brine to form the 'wetted' element of the de-icer. Brine is produced by adding salt to water forming a solution that has the most suitable de-icing characteristics when between 18% and 23%. Salt and water are mixed together to form the brine in saturators that tend to be installed in operational depots. It is thought that because of the large capital costs required in purchasing and installing saturators, pre-wetting is not particularly suited for footway treatments solely although if the carriageway treatment regime utilises pre-wetted salt, then the footways could also be treated using this de-icer to minimise costs in purchasing additional salt. (Some of the equipment listed in Appendix A is capable of spreading pre-wetted salt). Other benefits of using pre-wetted salt include fewer chlorides entering the environment (due to the make-up of the 'wetted' mixture and more accurate spreading).

Brine-only

As an alternative to pre-wetted spreading, numerous brine-only spreaders are available commercially for the treatment of footways. Because brine is a solution, the de-icing effect occurs much more quickly than that of dry salt and does not require footfall for activation, as mentioned in the pre-wetted section above.

Brine of can be delivered and bought in containers, and in itself is widely proven throughout Europe as an effective de-icer suitable for use in extreme cold temperatures and low humidity conditions. The London Borough of Wandsworth presently utilise a quad bike which tows a trailer complete with a liquid de-icer tank. Manufacturers such as Peacock, ESE Direct, Schmidt, and Glasdon all offer equipment that is capable of treating footways with brine as demonstrated in Appendix E.

Alternative de-icers

Alternative de-icers to salt include other liquid treatments that come in the form of acetates, such as potassium acetate, and these are more beneficial in treating structures such as bridges, as they are less as corrosive than salt. Urea (which comes in pellet form) is a dry alternative to potassium acetate, and is also widely used for treating structures and tunnels. As with potassium acetate, it has fewer corrosive characteristics when compared to dry salt.

Abrasives

Abrasive materials are also commonly spread on footways during icy conditions to provide traction. Additionally, when spread on lying snow/ice, abrasive materials such as sand have the ability to break up the compacted ice thereby aiding and accelerating the de-icing process. Abrasives can be spread alone or as part of a salt/sand mix, and numerous footway spreaders are available on the market with this treatment capability.

Summary

In summary, the recommended precautionary treatment for footways would be brine, as this method allows for accelerated de-icing effect when compared with dry-salt and requires no footfall for activation. This characteristic would therefore make brine an ideal solution for footways receiving low pedestrian levels, as it is in these areas where dry salt may not be properly activated. Under lying snow and ice, brine and pre-wetted treatments are not as effective. Instead the recommended method of treatment would be the use of dry salt, possibly alongside an abrasive such as sand. This would act to break up the compacted snow and ice and also to provide a de-icing effect.

6 Conclusions and Recommendations

6.1 Conclusions

This report has provided a detailed insight and guidance into footway treatment using case studies from some of the London authorities. Examining the guidance provided in Section 13 of Well Maintained Roads and legislation from the 1980 Highways Act, winter service practices have been examined alongside the options available for carrying out footway treatments including examples of running costs against capital costs and operational constraints of treating footways.

To date, the general practice for treating footways varies not only in London but across the country. As an industry, there is limited documentation surrounding the treatment of footways and this report has attempted to draw together specific industry-wide best practice and best knowledge in the production of the guidance herein. Should LoTAG wish to enhance the guidance in this note through the pursuit of more detailed knowledge on footway treatment dosages, it is recommended further research through an industry research group such as the National Winter Service Research Group (NWSRG) should be sought.

The discussion which took place in Section 4 regarding types of footway de-icing equipment has been summarised in Table 6.1 for quick reference. However to fully appreciate the context of the information below, the discussion should be read in full along with the relevant Appendices.

Table 6.1: Footway Equipment Guidance

	Manual Spreaders	Towed Spreaders	Mini-spreaders
Capital Cost	LOW	HIGH	HIGH
Operational costs	MEDIUM	LOW	HIGH
Typical ability (using example from Appendix D) to treat various footway lengths without need for refilling (based on 1.8m wide footway; 10g/m^2)			
1km footway	YES	YES	YES
2km footway	YES	YES	YES
3km footway	NO	YES	YES
5km footway	NO	NO	YES
10km footway	NO	NO	YES
Typical ability (using example from Appendix D) to treat various footway lengths without need for refilling (based on 4.0m wide footway; 10g/m2)			
1km footway	YES	YES	YES
2km footway	NO	NO	YES
3km footway	NO	NO	YES
5km footway	NO	NO	YES
10km footway	NO	NO	YES
Ability to operate under various pedestrian traffic levels*			
High levels	NO	NO	NO
Low levels	YES	YES	YES
Material types available to spread**			
Dry salt	YES	YES	YES
Brine only	YES	YES	YES
Pre-wetted salt	NO	NO	YES
Operational support levels required for refilling	HIGH	MEDIUM	LOW
Ability to operate in areas of dense street furniture	HIGH	LOW	MEDIUM
*The level of risk associated with operating under high levels of pedestrian traffic should be assessed by each authority			
**Specialist equipment required to be procured for brine-only and pre-wetted treatment			

Appendix A: Policy Reference

Winter Service Code of Practice

Section 13 of Well Maintained Highways (2009), offers guidance to highway authorities with respect to winter service, and as an introduction states the following -

> *13.1.6 The statutory basis for Winter Service varies in different parts of the UK. In England and Wales Section 41 (1A) of the Highways Act 1980 was inserted on 31st October 2003, by Section 111 of the Railways and Transport Act 2003.*

The first part of Section 41 reads:

> *a) The authority who are for the time being the highway authority for a highway maintainable at the public expense are under a duty, subject to subsections (2) and (3) below, to maintain the highway.*
>
> *b) (1) In particular, a highway authority are under a duty to ensure, so far as is reasonably practicable, that safe passage along a *highway is not endangered by snow or ice.*
>
> *13.1.7 This is not an absolute duty, given the qualification of 'reasonable practicability', but it does effectively overturn previous legal precedence, albeit not with retrospective effect. Section 150 of the Act still imposes a duty upon authorities to remove any obstruction of the highway resulting from 'accumulation of snow or from the falling down of banks on the side of the highway, or from any other cause'.*
>
> ** Highway includes footway*

Winter Service requires authorities to invest significantly in order to ensure their duty of clearing snow and ice is met. However, in reality it is rarely possible to provide winter service on all parts of the network (as set out in paragraph 13.1.9 of Well Maintained Highways, 2009).

To meet the aforementioned guidance, highway authorities have developed policies and operational plans often jointly referred to as a 'Winter Service Plan'. Within the Winter Service Plan, authorities state which routes will be treated during the winter season and how these will be treated (i.e. equipment, salt type, spread rate). At the same time, these routes will be prioritised in terms of their 'importance'.

Typically, the following hierarchy of treatment routes is used:

1. Major A roads (and B roads) which form strategic routes, (including bus routes, school routes, sections of network which form junctions with the motorway, all purpose trunk roads, and strategically defined roads.

2. Classified roads and other defined and names roads e.g. servicing commercial hubs

3. Minor roads (predominately the remaining B roads)

4. C roads and footways

5. Estate roads, unclassified roads and others

However, the following excerpt from paragraph 13.2.2 of Well Maintained Highways (2009) states that:

> *"Issues for consideration in developing policies should include…treatment of facilities for walking and cycling…"*

Footways themselves are often given their own hierarchy in terms of treatment prioritisation. For example, commuter routes and sections of footway surrounding hospitals and surgeries tend to be treated with a higher priority than footways seldom used and those on the periphery of major urban areas.

Legality of motorised vehicles working on the footway Introduction

This note has so far described existing policy and listed several case studies with regards to winter service and footway treatment in London. The London authorities discussed have varying methods of treating footways from manual salt spreading using shovels, to dedicated machinery such as liquid de-icer tanks towed by quad bikes.

To contextualise to analysis of equipment available on the market, it is worth considering the implications of treating footways using 'ride-on' equipment. A case study of this is the London Borough of Bromley, who in 2007 started a procurement process for the purchase of winter service vehicles, including footway

treatment equipment. Following on from other London authorities' success Bromley noted that although using such mechanical means for carrying out winter treatments decreases the time taken to complete the treatment, it was suggested that such operations can only be carried out when pedestrian flows are at their minimum (http://sharepoint.bromley.gov.uk/Public%20Docs/10-Gritters.doc).

Narrower footways and those with a multitude of street furniture also present significant problems when using ride-on equipment for the de-icing of footways. Indeed, the equipment itself may often be too large or wide to treat the footways in question.

An element of research has taken place with determining the legalities of using 'ride-on' salt spreading equipment on footways.

Section 41 of the 1980 Highways Act states that highway authorities have a duty to ensure that the public highways under their jurisdiction are kept free of snow and ice. Under the same act, section 300 states:

> *No statutory provision prohibiting or restricting the use of footpaths, footways or bridleways shall affect the use by a competent authority of appliances or vehicles, whether mechanically operated or propelled or not, for cleansing, maintaining or improving footpaths, footways or bridleways or their verges, for preventing or removing obstructions to them or otherwise preventing or abating nuisances or other interferences with them, or for maintaining or altering structures or other works situated therein.*

Taking into account the above, the use of ride-on vehicles is authorised for cleansing, maintaining or improving footpaths; "cleansing" and "maintaining" are able to be interpreted as precautionary and reactive treatments on snow and ice, and therefore the use of relevant vehicles carrying out these exercises is permissible.

Vehicle Regulations

Section 4 of the Vehicles (Conditions of Use on Footpaths) Regulations 1963. SI 1963 2126 makes reference to limitations on vehicle size and speed when on the footway imposed by regulations made in:

a. Weight - 1 Ton max
b. Speed – 5mph

Treatment Prioritisation

The treatment routes for Winter Service should take as a starting point the hierarchy developed for other maintenance purposes. However, this is likely to require extensive modification to consider:

- wider transport and other policy priorities referred to above;
- special requirements of carriageways, footways and cycle routes;
- safe and reliable access to emergency facilities including Fire and Rescue, Police, ambulance services and hospitals;
- other public services access needs and critical infrastructure where the maintenance of access may be critical;
- public transport routes and access to stations, bus garages and depots;
- safe and reliable access to main industrial and business centres of key importance to the local and regional economy;
- any significant variation between summer and winter traffic;
- accessibility dependencies of remote communities;
- the special needs of disabled people or older people particularly where these can be effectively targeted;
- known problems, including significant gradients, exposed areas and other topological factors;
- climatic and thermal capacity differences within the area;
- co-ordination and co-operation with other authorities.

London Resilience Footways

London Resilience Footways describes the minimum footway areas within the GLA boundary to be treated during winter service operations so that core essential services can operate. The footway resilience areas are designated by the Highway Authority.

The resilience areas should include locations which have either exceptionally high usage or are primary pedestrian routes, providing access to key services, including:

- hospitals
- medical centres
- key employment sites
- Primary and Secondary schools town centres

The footway resilience areas should include 20 metres either side of the main entrance to individual premises. They may not be linked but should provide access

to the closest bus stop and the road resilience network, where this is practical. The footway areas should provide continuity across borough boundaries.

In addition, the footway resilience areas should include:

- footways within key public transport interchanges and links between rail/underground/DLR stations and the closest bus stop on the road resilience network; and
- steep hills or other locations known to be unsafe for pedestrians in severe winter weather.

Appendix B:
Examples of Current Practice within London

Examples of current practice from twelve London authorities are set out below:

London Borough of Newham

The precautionary treatment of footways (or cycleways) does not take place in Newham at present. Newham does, however, operate a monitoring system whereby council employees and others, on a voluntary basis, give feedback on the occurrence of frost and ice around the Borough. Newham will use the results to help decide which footways (and cycleways), if any, require precautionary treatment.

London Borough of Redbridge

The precautionary treatment of footways throughout Redbridge is reliant on the overspill of salt when the main carriageways are being treated. This process however is becoming less effective year on year due to the increased presence of parked vehicles. During prolonged snow periods, Redbridge treats footways based around shopping areas, schools, hospitals, sheltered housing, and railways stations etc. Salt bins are also strategically placed throughout the borough which are filled at the start of each winter season and maintained by the councils Street Cleansing Operatives.

London Borough of Wandsworth

Although Wandsworth does not undertake precautionary treatment of footways, when snow is forecast their 'hotspot' routes are pre-salted by hand with dry rock salt. Hotspots include footways in the vicinity of hospitals, schools, bus and rail stations. Priority is also given to areas where refuse collections are due to take place. Although the majority of treatment routes are completed manually, Wandsworth also has a quad bike which tows a container of liquid de-icer. The advantage of this is that the de-icer is already in solution and therefore does not require a certain level of humidity/moisture or 'trafficking' to prevent the formation of ice.

London Borough of Barnet

Barnet categorises its footway treatments as follows:

- Priority 1 = those that receive a precautionary treatment to prevent the formation of ice

- Priority 2 = those that receive a reactive treatment when snow and ice persist.

Priority 1 routes have been assigned by completing risk assessments, and assessing areas of importance such as those footways surrounding transport hubs, hospitals and town centres. These routes are treated before the start of the morning rush hour by small manually operated spreading machines.

Priority 2 treatments are undertaken on a hierarchical basis and are dependent on the weather conditions that exist when the decision to treat is made. Footways leading to - and within - town centres, steep slopes and other vulnerable areas are treated first, followed by footways leading to traffic interchanges and "vulnerable" buildings such as hospitals. Whereas Priority 2 treatments are carried out manually, Barnet has three dedicated footway spreading machines which are capable of treating at varied spread rates. Priority 1 treatments are undertaken using 6mm rock salt, spread at a rate of $10g/m^2$.

London Borough of Richmond

Richmond's existing winter service policy statement describes the prioritisation given to all routes (including carriageways) throughout winter. Footways are prioritised second to carriageways, and as such footways are treated by post salting in extreme weather to dissolve ice and snow that has already formed to keep delays and accidents to a minimum. Section (j) of Richmond's policy statement prioritises the post event treatments as follows –

1. Primary walking routes (town centres, high streets)
2. Secondary walking routes (stations, hospitals, libraries, day centres, school - term time only)
3. Link footways
4. Local access footways.

London Borough of Hammersmith and Fulham (H&F)

Hammersmith and Fulham has defined locations where the footways are treated. No distinction is made between "normal" and under "resilience" conditions when treating footways. The following criteria are used in the treatment of footways:

- heavy pedestrianised areas;

- key community facilities;
- town centres; and
- schools.

Hammersmith and Fulham does not use accident, pedestrian count data or other evidence to inform the locations to be treated. Nor does it automatically treat all footways adjacent to the Winter Resilience Road Network. H&F currently treats the footways using the manual method of wheelbarrows and shovels, although they will soon be introducing hand pushed spreaders.

London Borough of Lambeth

The Lambeth has a definitive Footway Winter Resilience Network. No distinction is made between "normal" and under "resilience" conditions when treating footways. The following criteria are used in the treatment of footways:

- heavy pedestrianised areas;
- steep hills;
- schools;
- transport interchanges;
- emergency service stations; and
- town centres

Lambeth does not use accident, pedestrian count data or other evidence to inform the locations to be treated. The Borough does not automatically treat all footways adjacent to the Winter Resilience Road Network, unless these locations come under the criteria used in the treatment of footways. The Borough currently treats the footways using salt or sand, which is distributed using the manual method of wheelbarrows and shovels. Detailed mapping has been provided in relation to the Footway Winter Resilience Network.

London Borough of Westminster

Westminster has defined locations where the footways are treated. No distinction is made between "normal" and under "resilience" conditions when treating footways. The following hierarchy criteria are used in the treatment of footways:

- steep hills and inclines;
- steps and ramps of subways;

- hospitals;
- fire stations;
- police stations;
- doctors surgeries;
- nursing homes;
- schools;
- public buildings and other facilities;
- transport interchanges;
- decks and steps of footbridges;
- junctions and crossing points;
- footways on the eastern side of terraces or between mansion block-type housing lying north / south; and
- footways in essentially residential areas that include none of the aforementioned.

The hierarchy of priorities applied to footways is determined by criteria such as the following:

- geographical features,
- type and intensity of use,
- pattern of loss of the urban heat-island effect.

Westminster does not automatically treat all footways adjacent to the Winter Resilience Road Network, unless these locations come under the criteria used in the treatment of footways. The Borough currently treats footways using the manual method of barrows and shovels, and the mechanical method of using "Powerflex". Detailed mapping is not available, but a list of locations where the footways are treated on the Footway Winter Resilience Network is available, and can be supplied if required.

London Borough of Bromley

Bromley has a definitive Footway Winter Resilience Network. A distinction is made between "normal" and under "resilience" conditions when treating footways, with the following locations being treated under "resilience" conditions:

- all retail centres;
- all transport interchanges; and
- approaches to schools.

The following criteria are used in the treatment of footways:

- heavy pedestrianised areas;
- key community facilities;
- town centres;
- transport interchanges;
- schools;
- hospitals;
- medical centres; and
- steep hills.

Bromley does not use accident, pedestrian count data or other evidence to inform which locations are to be treated. Bromley does not automatically treat all footways adjacent to the Winter Resilience Road Network. Detailed mapping has been provided in relation to the Footway Winter Resilience Network.

London Borough of Southwark

Southwark has a definitive Footway Winter Resilience Network, as well as defined locations where the footways are treated. This depends on the prevailing and / or anticipated weather conditions, as well as the availability of salt, which in turn is subject to salt cell intervention. The following criteria are used in the treatment of footways:

- town centres;
- transport interchanges;
- schools;
- day centres; and
- emergency service stations.

Southwark does use accident, pedestrian count data or other evidence to inform the locations to be treated, but overlaid on this is the perceived hazard (i.e. it may be a location of high footfall which is particularly vulnerable to freezing).

Southwark does not automatically treat all footways adjacent to the Winter Resilience Road Network, unless particularly hazardous. The Borough currently grits the footways using the manual method of barrows and shovels. Detailed mapping is not available, but a list of locations where the footways are treated on the Footway Winter Resilience Network is available, which can be supplied if required.

London Borough of Ealing

Footways are only gritted in settled snow conditions. No distinction is made between normal and resilience networks. Criteria include:

- outside school entrances;
- hospital entrances; and
- other high profile places of activity.

London Borough of Enfield

Footways are only gritted in settled snow conditions. Enfield has a footway gritting network but do not distinguish between "normal" and "resilience". They indicated that in severe weather resources are shifted to roads and they must decrease resources away from footways, so in fact footways may receive less treatment under resilience conditions. In general the roads that are gritted will have their footways cleared simultaneously.

Appendix C: Treatment Capacity By Equipment Type

Assumptions
For a 1.0m length of footway, 1.8m wide the area is 1.8m²
Therefore, for a 20g/m² treatment the weight of salt used is:
1.8m x 20g = 36g per metre of footway
Therefore, for a 10g/m² treatment the weight of salt used is:
1.8m x 10gm = 18gm per metre of footway
Push/walking speed = 2km/hr
Hand pushed potential H&S implications (operating the equipment on ice)

Manual
Peacock Dolomite Manual/Push
50kg capacity, or 50,000g
Total treatable length:
50,000/36 = 1389m or 1.39km or 2.78kms at 10gm/m2

Towed Small Towed
BSS International Everest
150kg capacity
Total treatable length:
150,000/36 = 4167m or 4.17km or 8.34km at 10gm/m2
So weight capacity is 1/0.83 x 0.05m³ = 0.060t or 60,241g
Total treatable length:
60,241/36 = 1673m or 1.67km or 3.34km at 10gm/m2

Towed Large Towed
Vale PO21 FEED TS500
0.5m³ hopper
1 tonne of salt = 0.83m³
So capacity is 1/0.83 x 0.5m³ = 0.602t or 602,000g
Total treatable length:
602,000/36 = 16,772m or 16.72km or 33.44km at 10gm/m2

Powered Small
BSS International Powered Everest
250kg capacity
Total treatable length:
250,000/36 = 6944m or 6.94km or 13.88km at 10gm/m2

Romaquip Micro Spreader Large
0.5m³ hopper
1 tonne of salt = 0.83m³
So capacity is 1/0.83 x 0.5m³ = 0.602t or 602,000g
Total treatable length:
602,000/36 = 16,772m or 16.72km or 33.44km at 10gm/m2

Appendix D: Operational Costs

OPERATIONAL COSTS

Assumptions	
All operational costs are based on the treatment of 5000m^2 of footway (1.8m width) at 20g/m^2, 50 times per season	
Cost of salt per tonne	£25
Cost of operator per hour	£20
Annual cost of maintenance	10% capital cost
Walking speed (accounting for refills)	2km/h
Treatment speed for towed spreader/mini spreader	7.5km/h
Fuel costs per km	£0.50
Average distance travelled to treatment location for manual spreading	2km
Number of operatives in used for manual spreading (note this is based on two spreading operatives per van - i.e. the cost of driver is split between two operatives)	1.5
Cost of 500cc quad bike used for towing option	£6,500

		20 gm/m2		**10 gm/m2**
MANUALLY OPERATED:				
R E Daniel - EV-N-Spreader 2040Pi (£125)				
Capital Cost		***£ 125.00***		***£ 125.00***
Salt required to treat 5000m^2 (2.78 Lane km)	0.1 tonnes		0.05 tonnes	
Wastage	20%		10%	
Total salt required	0.120 tonnes		0.055 tonnes	
Cost of salt used		***£ 3.00***		***£ 1.38***
Time required to complete treatment	1.39 hours		1.39 hours	
Cost of operator (1.5 operators)		***£ 41.70***		***£ 41.70***
Distance to treatment site	2km		2km	
Fuel costs		***£ 2.00***		***£ 2.00***
Running costs per season (50 runs)		***£ 2,335.00***		***£ 2,254.00***
Annual maintenance		***£ 12.50***		***£ 12.50***
TOTAL RUNNING COST PER SEASON inc Salt		***£ 2,347.50***		***£ 2,266.50***

TOWED:				
BSS International - Everest (£1,000)				
Capital Cost (spreader)		***£ 1,000.00***		***£ 1,000.00***
Capital Cost (towing vehicle - 500cc quad bike)		***£ 6,500.00***		***£ 6,500.00***
Salt required to treat 5000m^2 (2.78 Lane km)	0.1 tonnes		0.05 tonnes	
Wastage	15%		7.50%	
Total salt required	0.115 tonnes		0.054 tonnes	
Cost of salt used		***£ 2.88***		***£ 1.35***
Time required to complete treatment	0.38 hours		0.38 hours	
Cost of operator		***£ 3.80***		***£ 3.80***
Fuel costs		***£ 1.39***		***£ 1.39***
Running costs per season (50 runs)		***£ 403.50***		***£ 327.00***
Annual maintenance		***£ 750.00***		***£ 750.00***
TOTAL RUNNING COST PER SEASON inc Salt		***£ 1,153.50***		***£ 1,077.00***
MINI SPREADER:				
Romaquip Mini Spreader (£35,000)				
Capital Cost		***£ 35,000.00***		***£ 35,000.00***
Salt required to treat 5000m^2 (2.78 Lane km)	0.1 tonnes		0.05 tonnes	
Wastage	10%		5%	
Total salt required	0.110 tonnes		0.053 tonnes	
Cost of salt		***£ 2.75***		***£ 1.33***
Time required to complete treatment	0.38 hours		0.38 hours	
Cost of operator		***£ 3.80***		***£ 3.80***
Fuel costs		***£ 1.39***		***£ 1.39***
Running costs per season (50 runs)		***£ 397.00***		***£ 326.00***
Annual maintenance		***£ 3,500.00***		***£ 3,500.00***
TOTAL COST PER SEASON		***£3,897.00***		***£3,826.00***

Appendix E: Footway Treatment Equipment

Manual spreaders

Supplier	Type	Equipment	Costs	Suitable for all salt types?	Capacity	Unlaiden weight	Treatable length at 10g/m2 (see Appendix C)	Benefits	Issues	Notes	Suggested Operational Use
ESE Direct	Manual /Push	 "S25-Sprayer"	£453.50 (excludes VAT)	Wet	25lt	14kg	0.8km	Flexible usage where street furniture is prevalent. Suitable for structures through use of potassium acetate or urea	Limited treatable lengths	Width 0.35m	Utilise a small pick up vehicle to carry operators, equipment and approx suitable volume of liquid de-icer. Vehicle would drop operators at specific points and be on hand to refill equipment
Peacock	Manual /Push	 "Neptune"	£560.00 per unit	Liquid only	25lt	14kg	0.8km	Potential for using different liquid de-icers e.g. brine, potassium acetate. Suitable for bridges and the like Spray system ensures dosage low to the ground	Width 0.55m Suitable for bridges and the like Spray system ensures dosage low to the ground	Width 0.45m	Utilise a small pick up vehicle to carry operators, equipment and approx suitable volume of liquid de-icer. Vehicle would drop operators at specific points and be on hand to refill equipment
R E Daniel	Manual /Push	 "EV-N-Spreader 2040Pi"	£125.00 (excludes VAT)	Dry	15kg	6kg	0.83km	Flexible usage where street furniture is prevalent. Light and manoeuvrable	Limited capacity therefore only short distances treatable	Width 0.4m optional deflector to reduce spread width	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment

Supplier	Type	Equipment	Costs	Suitable for all salt types?	Capacity	Unlaiden weight	Treatable length at 10g/m2 (see Appendix C)	Benefits	Issues	Notes	Suggested Operational Use
Peacock	Manual /Push	 "Atlas"	£205.00 per unit	Dry only	25kg	7.2kg	1.39km	Flexible usage where street furniture is prevalent Lightweight. 3m spread width Corrosion free plastic hopper	Limited capacity therefore only short distances treatable	Width 0.36m Also features adjustable spread rate	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
Peacock	Manual /Push	 "Claudius"	£149.00 per unit	Dry only	25kg	5.8kg	1.39km	Flexible usage where street furniture is prevalent Lightweight. 3m spread width Corrosion free plastic hopper	Potential for using different liquid de-icers e.g. brine, potassium acetate.	Width 0.66m Adjustable 'flow' rate. Able to spread accurate dosages	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
BSS International	Manual /Push	 "BM Spreader"	£210.00	Dry	30kg	8kg	1.67km	Flexible usage where street furniture is prevalent. Adjustable spread rate, multi vain spinner. Light and manoeuvrable	25tlr hopper capacity provides limited treatment lengths High reloading required	Width 0.46m	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
BSS International	Manual /Push	 "Matterhorn"	TBC (average £230.00)	Dry	30kg	8kg	1.67km	Flexible usage where street furniture is prevalent. Adjustable spread rate, multi vain spinner. Light and manoeuvrable	25tlr hopper capacity provides limited treatment lengths High reloading required	Width 0.46m adjustable spread rate, stainless steel multi vain spinner	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment

Supplier	Type	Equipment	Costs	Suitable for all salt types?	Capacity	Unlaiden weight	Treatable length at 10g/m2 (see Appendix C)	Benefits	Issues	Notes	Suggested Operational Use
R E Daniel	Manual /Push	 "EV-N-Spreader 2130"	£250.00 (excludes VAT)	Dry	30kg	13kg	1.67km	Flexible usage where street furniture is prevalent. Light and manoeuvrable Limited capacity therefore only short distances treatable	Limited capacity therefore only short distances treatable	Width 0.4m optional deflector to reduce spread width	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
Schmidt	Manual /Push	 "Pavemaster"	£200 .00	Dry only	30kg	unknown	1.67km	Potential for using different liquid de-icers e.g. brine, potassium acetate. Suitable for bridges and the like Spray system ensures dosage low to the ground Compact 1-4m spread width	Potential for using different liquid de-icers e.g. brine, potassium acetate.	Pneumatic tyres	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
ESE Direct	Manual /Push	 "CEMO SW35-E Stainless Steel Frame Spreader"	£267.30 (excluding VAT)	Dry	35kg	9.5kg	1.94km	Flexible usage where street furniture is prevalent. 1-4m spread width, corrosion proof polyethylene hopper, adjustable spread rate Light weight	35tlr hopper capacity provides limited treatment lengths High reloading required	Width 0.48m stainless steel frame and axle, anti compression assembly to improve flow of salt / grit etc, pneumatic wheels	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
ESE Direct	Manual /Push	 "CEMO SW35-E Stainless Steel Frame Spreader"	£773.15 (excluding VAT)	Dry	50kg	35kg	2.78km	50ltr capacity, 5m spread width, corrosion proof polyethylene hopper and rigid cover, adjustable spread rate, speed and direction adjustment	Limited capacity therefore only short distances treatable	Width 0.61m stainless steel frame and axle, anti compression assembly to improve flow of salt / grit etc, pneumatic wheels with snow profile	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment

Supplier	Type	Equipment	Costs	Suitable for all salt types?	Capacity	Unlaiden weight	Treatable length at 10g/m2 (see Appendix C)	Benefits	Issues	Notes	Suggested Operational Use
Glasdon	Manual /Push	 "Icemaster Manual 50™ Gritter"	£297.83 (excluding VAT)	Dry	50kg	55kg	2.78km	Flexible usage where street furniture is prevalent. Tubular steel frame and corrosion-proof plastic hopper.	Limited capacity therefore only short distances treatable	Width 0.670m adjustable flow control mechanism, directional control	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
Glasdon	Manual /Push	 "Cruiser Manual 50™ Gritter"	£844.11(excluding VAT)	Wet, Damp and Dry	50kg	48kg	2.78km	Flexible usage where street furniture is prevalent 500mm spread width	Limited capacity therefore only short distances treatable	Width 0.790m pre-defined width controlled spreading,	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
Peacock	Manual /Push	 "Taurus"	£500.00 per unit	Dry only	50kg	unknown	2.78km	Flexible usage where street furniture is prevalent Lightest of the 'hand operated' models. Can use most 'dry' salts of standard particle size	Limited capacity therefore only short distances treatable	Width 0.83m spread width. 50kg capacity	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
Peacock	Manual /Push	 "Dolomite"	£605.00 per unit	Dry only	50kg	32kg	2.78km	Flexible usage where street furniture is prevalent Corrosion free plastic hopper Robust		Width 0.61m Also features directional spreading	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment

Supplier	Type	Equipment	Costs	Suitable for all salt types?	Capacity	Unlaiden weight	Treatable length at 10g/m2 (see Appendix C)	Benefits	Issues	Notes	Suggested Operational Use
Glasdon	Manual /Push	 "Cruiser Turbocast 300™ Gritter"	£988.50 (excluding VAT)	Wet, Damp and Dry	52kg	unknown	2.89km	Flexible usage where street furniture is prevalent Robust Adjustable 3-7m spread width	Limited capacity therefore only short distances treatable	Width 0.67m Controlled dosing, corrosion-resistant double-skinned Durapol® material, extra durable Armortec® coated chassis.	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
Bunce	Manual /Push	 "Epoke EpoMini 5"	£200.00	Dry	60kg	30kg	3.33km	Flexible usage where street furniture is prevalent. Light and manoeuvrable 550mm spread width therefore only suitable for treating half a footway in a single pass		Width .75m	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment
BSS International	Manual /Push	 "Olympus"	£230.00	All	60kg	20kg	3.33km	Flexible usage where street furniture is prevalent. Adjustable spread rate, multi vain spinner. Light and manoeuvrable	Limiting 0.94m spread width, cannot treat full footway in a single pass.	Width 0.94 adjustable spread rate, drop feed, stainless steel working parts, pneumatic tyres	Utilise a small pick up vehicle to carry operators, equipment and approx 1 tonne of salt. Vehicle would drop operators at specific points and be on hand to refill equipment

Towed Spreaders

Supplier	Type	Equipment	Costs	Suitable for all salt types?	Capacity	Unlaiden weight	Treatable length at 10g/m2 (see Appendix C)	Benefits	Issues	Notes	Suggested Operational Use
Glasdon	Tow		Est £2000	Dry	160kg	360	8.8km	160ltr hopper capacity, 800mm spread width, adjustable spread rate	As the equipment must be towed, more than likely that it will be too large for treating the majority of footways in London	Width 1.275m	Towable - hopper filled at depots
Bunce	Tow	"Epoke EpoMini 20" 	£2,000.00	Dry	200kg	75kg	11.1km	200ltr hopper capacity, 800mm spread width, adjustable spread rate	As the equipment must be towed, more than likely that it will be too large for treating the majority of footways in London.	1.065m width	Towable - hopper filled at depots
BSS International	Tow	"Everest" 	£1,000.00	All	250kg	150kg	13.9km	hopper capacity, strong non corrosive hopper, 2-6m spread width	Potentially difficult to treat areas with many items of street furniture	Width 0.8m adjustable spread rate, stainless steel spinner, pneumatic tyres, Adjustable tow bar for 50mm ball or pin, variable speed	Towable - hopper filled at depots
BSS International	Tow	"Powered Everest" 	£2,000.00	All	250kg	250kg	13.9km	150kg / 250kg (with extension) hopper capacity, strong non corrosive hopper, 2-6m spread width	Limited conspicuity - lack of beacons and markings	Width 0.8m adjustable spread rate, stainless steel spinner, pneumatic tyres, variable speed	Dedicated equipment. Potential to be kept in operational depots and also 'garaged' near to priority 1 routes

Supplier	Type	Equipment	Costs	Suitable for all salt types?	Capacity	Unlaiden weight	Treatable length at 10g/m2 (see Appendix C)	Benefits	Issues	Notes	Suggested Operational Use
BSS International	Tow	 "Powered Everest"	£1,400.00	All	250kg	150kg	13.9km	250kg hopper capacity, strong non corrosive hopper, 2-6m spread width	Potentially difficult to treat areas with many items of street furniture	Width 0.8m adjustable spread rate, stainless steel spinner, pneumatic tyres, fully lighted and mud guards, suitable to be towed on the highway, optional yellow flashing light, variable speed	Towable - hopper filled at depots
Bunce	Tow	 Epoke Intercity		Brine	300/400/600	90/95/135/150kg		The De-icing sprayers are available in sizes ranging from small sprayers suitable for Compact Tractors, slightly larger ones suitable for standard sized Agricultural Tractors and larger units for Mounting onto the back of small pick ups up to large units for mounting onto Lorries.	Not suitable on compacted ice nor snow. Precautionary treatments only. Towing vehicle required to drive across footway	Width 1.100 – 1.200m Particularly good for treating Cycle Ways, Shopping Precincts, Footpaths and small roads.	Where there is a low volume of traffic so the normal salt would not be agitated to help it to start working properly
Bunce	Tow	 Epoke ITM35/45/60		Dry	350/450/600kg	145/195/200kg	18.9-33.3km	350 l road speed related, wheel driven towed ‘drop’ salt spreader with rear road lights and drawbar with 50mm ball hitch and 35mm eye	As the equipment must be towed, more than likely that it will be too large for treating the majority of footways in London.	Width s: 1.150/1.435/1.885m The spread rate is easily adjusted by changing the tension on the spring base via a handle on the back of the spreader. These spreaders are more robust than the EpoMini or PM range of spreaders and they are simple to operate and maintain	Hopper to be filled with salt at operational depots or from support vehicle

Supplier	Type	Equipment	Costs	Suitable for all salt types?	Capacity	Unlaiden weight	Treatable length at 10g/m2 (see Appendix C)	Benefits	Issues	Notes	Suggested Operational Use
Vale	Tow	 "POZI - FEED TS500"	£5,000.00	Wet and Dry	600kg	250kg	33.3km	1.22m wide 0.5m³ Hopper, adjustable spread width 1.2m to 3m, symmetric and asymmetric patterns achievable, 60 Litre hydraulic tank “Pozi–Feed” double Auger, adjustable application rate 0 to 50kgs per min	As the equipment must be towed, more than likely that it will be too large for treating the majority of footways in London.	1.22 metres wide with an overall length of 3 metres, All metal work blast cleaned, prior to zinc rich powder prime and finished in Polyester Powder Finish, Axles fitted with suspension and automatic brakes, road going wheels and tyres. Optional: •Ring type hitch instead of 50mm ball type hitch •Rear mounted beacon •Stainless steel augers	Hopper to be filled with salt at operational depots
Romaquip	Tow	 "Mini"	Approximately £35,000	Dry only	960-2400kg	1.2 tonne	53-133km	Designed for trailer and flat bed vehicles Stainless steel constructions - longer lifespan with little maintenance. Height adjustable - ensuring de-icer hits target areas.	As the equipment must be towed, more than likely that it will be too large for treating the majority of footways in London.	Width 1.625m Available in 0.8 - 2m^3 hopper capacity	Hopper to be filled with salt at operational depots
Schmidt	Tow	 "Compact Footway Sprayer (CSP)"	£2,000.00	Liquid only				Towed piece of equipment, therefore no H&S risk with regards to operator 'pushing' kit. Liquid spreader - fewer chlorides entering environment and faster rate of de-icing	Not suitable on compacted ice nor snow. Precautionary treatments only. Towing vehicle required to drive across footway	Est.Width 1.5m Minimum dosage down to 4g/m^2	Where liquids only are required, e.g. on structures

Mini-spreaders

Supplier	Type	Equipment	Costs	Suitable for all salt types?	Capacity	Unlaiden weight	Treatable length at 10g/m2 (see Appendix C)	Benefits	Issues	Notes	Suggested Operational Use
Romaquip	Vehicle Mounted	 "Micro-spreader"	Est £15,000	Dry only	420-960kg	unknown	23.3 - 53.3km	Designed for trailer and flat bed vehicles Stainless steel constructions - longer lifespan with little maintenance. Spring loaded spinner assembly - reduces damage to any rear collisions	Width 1.325m Maintenance and servicing costs to consider once out of warranty	Width 1.45m Available in hopper capacity	Hopper to be filled with salt at operational depots
Schmidt	Vehicle Mounted	 "Stratos	Est £5,000	Liquid/Pre-wet/Dry/Specials	720-2040kg	320-480kg	30 – 105km	Vehicle mounted depots, car parks, cycle paths and footpaths as well as narrow lanes in old town centre's . Available in hopper sizes of 0.6m3 to 1.7m3	Likely to be too large for treating most footways in London	Width: 1.035 – 1.500m	Hopper to be filled with salt at operational depots
Romaquip	Vehicle Mounted	 "Demount Mini Salt Spreader"	£20,000	Dry only	960-2400kg	unknown	53-133km	Designed for trailer and flat bed vehicles complete stainless steel construction, reduced maintenance costs	1.625m wide Maintenance and servicing costs to consider once out of warranty	height adjustable	Hopper to be filled with salt at operational depots
Schmidt	Vehicle Mounted	 "Traxos"	£12,000	Dry (incl urea)	1080/1440/1800/2160kg	550/600/660/700kg	60/80/100/120km	2-6m spread width. 5 - 40g/m^3 dosage. Tipper style 'self loading' - reduces operator input	Likely to be too large for treating footways in London	Width 1.035 – 1.105m	Hopper to be filled with salt at operational depots