CITY OF KELOWNA

MEMORANDUM

Date: December 30, 2005

File No.: 1280-01

To: City Manager

From: Roads & Equipment Superintendent

Subject: **WINTER ROAD MAINTENANCE AND SIDEWALK INSPECTION POLICIES**

RECOMMENDATION:

THAT Council approve continuing with the present day service level for sidewalk snow clearing;

AND THAT Council adopt the attached Snow & Ice Control Policy No. 332;

AND FURTHER THAT Council adopt the attached Sidewalk Inspection Policy No.331;

AND FURTHER THAT Council adopt the attached Salt Management Plan, prepared by Ecoplans Limited, dated November, 2005.

DISCUSSION:

1. **Sidewalk Snow Removal** - In July 2005 Council received a copy of a letter from a Paret Road resident claiming the City's practice of expecting property owners to keep sidewalks clear of ice and snow is unreasonable. In response to the letter Mayor Gray informed the resident that staff would conduct an internal study to determine if the City should take responsibility for some sidewalks, particularly where there are hills or unusual terrain problems.

   The Traffic By-law No. 8120, Section 2.5.1 presently states *"Owners or occupiers of real property shall remove snow, ice, or rubbish from the sidewalk and walkways bordering on the real property owned or occupied by them within 24 hours of the accumulation of such snow, ice or rubbish on such sidewalk."* Not withstanding the forgoing, Council has directed staff thru the Budget process to provide an In-kind service to the residents by plowing all sidewalks following a snow storm of 5 centimeters (2 inches) or more.

   The City currently clears 302 kilometers of sidewalk using three City owned sidewalk plows and employs three contractor plows for this purpose. Additional staff is sent out with hand shovels to clear snow from the nodes and wheel chair ramps in the Downtown and Town Center Improvement Districts and various stairways.

   The City's sidewalk network is divided into five main routes; the sidewalks within each route are assigned a priority from 1 to 3 reflecting the order they are to be cleared. Priority 1 are sidewalks downtown, sidewalks surrounding City owned property and businesses abutting them. Priority 2 are sidewalks fronting bus routes, schools and on major arterial roads that

have no residences or businesses abutting them. Priority 3 are sidewalks fronting residences. Plows are deployed at the end of a snow storm and all sidewalks are completed within 24 hours. Plows may be dispatched during a snow storm when accumulation and conditions warrant. Our annual Budget for snow removal on sidewalks is $45,798. An increased level of service is provided at the Queensway Transit Mall. Due to the volume of pedestrian traffic in this area crews are dispatched soon after a storm begins and clears snow from all sidewalks and medians. Our annual Budget for Queensway is $20,166.

We surveyed our neighbouring communities to see how our service level compared. The following is a summary of our findings:

Municipality	Inventory (kms)	Location	Service Level (hrs.)	Frequency
Kelowna	302	- All	24	> 5cm
Kamloops	40	- Next to multi-lane roads	16	All
Vernon	16	- Adjacent to city owned property - Highway 97 & 27th Ave.	24	All
Penticton	15	- Parks, bridges & city owned property	Regular hours only	>2.5cm
Prince George	150	- Downtown - Major Arterials - Schools & Senior Care Homes where possible - Residential whenever possible	As long as it takes (normally 26 hrs.)	> 5cm

Staff is recommending staying with the present day standard due to the following restraints:

Equipment: Due to our climate, the majority of our snow has very high moisture content and quickly packs down when walked on. In order to keep the equipment light enough and narrow enough to run on the sidewalks we use municipal tractors which are capable of pushing large volumes of snow but are unable to cut thru the compact and are very costly. Contractors typically use ATV's which can not push large volumes and can not cut thru the compact. Our tractors are used in the contractor areas when large accumulations make it impossible for the ATV's to push.

Manpower: In order to increase our service level we would have to employ enough people to physically clean all sidewalks using hand shovels. This would take a large group of staff and work would have to be found for them during non-snow events. This would be very costly and time consuming. Even if this was to be accomplished using non-City staff it would be very difficult to administer.

Financial: The cost of maintaining the Queensway Transit Mall is nearly half of the cost of maintaining the remaining sidewalks. If we were to increase the level of service on all sidewalks we could expect the cost to escalate.

2. **Snow & Ice Control Policy** – The attached Policy for Snow & Ice Control has been used by the Roadways Division to determine budget, manpower and service levels for the past several years. The Policy has proven to be very effective and achievable.

3. **Sidewalk Inspection Policy** – The attached Policy for Sidewalk Inspection has been used by the Roadways Division for the past several years. We inspect our sidewalks for trip hazards annually. Existing budget levels are sufficient to complete all priority one hazards on an annual basis. Priority two and three trip hazards are repaired within the limitations of resources.

4. **Salt Management Plan** – Under the Canadian Environmental Protection Act, the Government of Canada published a Code of Practice for the Environmental Management of Road Salts on April 3, 2004.

   The Code of Practice indicates municipalities that use more than 500 tonnes of salt per year should prepare a Salt Management Plan. We had to file a notification of intent with Environment Canada by October 3, 2004 and complete the plan by April 2005. At this time, this is still voluntary.

   During 2005 Budget review, Council approved the hiring of a consultant to complete the plan. A Tender was issued and EcoPlans was hired to work with City staff to put together the attached Salt Management Plan. This plan identifies potential negative impacts to the environment from our handling and storage of road salts.

   This process is in keeping with the City's commitment to implement the National Quality Institute's Progressive Excellence Program. Any action items requiring additional funding would still require Council approval through the Budget process.

Approved for inclusion

Dale Beaudry
Roads & Equipment Superintendent

John Vos
Director of Works & utilities

Attachment

cc: Transportation Manager

CITY OF KELOWNA

POLICY: **331**
PAGE: 1 of 3

COUNCIL POLICY MANUAL

APPROVAL DATE:@
RESOLUTION #:@
REPLACING #:N/A
DATE OF LAST REVIEW:@

DRAFT

SUBJECT: SIDEWALK MAINTENANCE AND INSPECTION

1. INTRODUCTION

The City of Kelowna has over 300 kilometers of public sidewalks. Public sidewalks vary in age and condition. The City recognizes that some sidewalk conditions can create unreasonable hazards for pedestrians and other sidewalk users.

The City does not have unlimited employee or financial resources and cannot reasonably replace all sidewalks needing replacement or repair within the same year the sidewalk is identified as needing repair or replacement. Sidewalk repair and replacement can be costly. Comprehensive sidewalk surveys are expensive and require the use of limited City personnel and other resources.

Accordingly, the City and its Transportation Department shall exercise both reasonable discretion and professional judgment in determining if and when sidewalks need to be repaired or replaced. The City expects that its agents, employees, and officials will exercise reasonable discretion in identifying conditions requiring repair and replacement, in the scheduling of repair and replacement, and in establishing priorities for repair and replacement.

2. SIDEWALK INSPECTION PROCEDURES

Inspections shall not take place until all the frost is out of the ground, snow has melted and spring sweep completed.

Inspections are to be completed following the sidewalk inventory sheets for each area.

Inspections will be carried out by a qualified person so as to maintain consistency in the way the inspections are recorded.

Hazards are to be recorded on the field survey form as per the following ratings;

HAZARD TYPES:	DEFENITIONS:	HAZARD RATINGS:
1. Cracks or Separations	Crack in sidewalk panel with no deflection	1. More than 2.5 cm in width 2. 1.25 cm to 2.5 cm in width 3. Less than 1.25 cm in width
2. Heave or Settlement	Any change in elevations whether it's at a crack or a joint	1. More than 2.5 cm in height/depth 2. 1.25 cm to 2.5 cm in height/depth 3. Less than 1.25 cm in height/depth

CITY OF KELOWNA

COUNCIL POLICY MANUAL

APPROVAL DATE:@
RESOLUTION #:@
REPLACING #:N/A
DATE OF LAST REVIEW:@

SUBJECT: SIDEWALK MAINTENANCE AND INSPECTION

3. Deflections	Where one or two panels have either heaved or settled with no change in elevation @ the joint or crack	1. More than 5 cm change over 1.5 M 2. 2.5 cm to 5 cm change over 1.5 M 3. Less than 2.5 cm change over 1.5 M
4.Filets	Any section within the sidewalk that is smaller than the neighbouring panels	1. More than 2.5 cm in height/depth 2. 1.25 cm to 2.5 cm in height/depth 3. Less than 1.25 cm in height/depth
5. Scaling	Top layer of concrete is failing, leaving the appearance of exposed aggregate	1. More than 2.5 cm in depth 2. 1.25 cm to 2.5 cm in depth 3. Less than 1.25 cm in depth
6. Obstacles	Items such as rebar sticking out of the concrete	1. More than 2.5 cm in projection/depression 2. 1.25 cm to 2.5 cm in projection/depression 3. Less than 1.25 cm in projection/depression
7. Other	Any other item you feel should be brought to your supervisor's attention such as handrails, vegetation, holes, overhead obstructions, etc.	1. Severe 2. Moderate 3. Low

Upon completion of inspections in an area, the foreman will copy the field survey form and will attach the original to the inventory sheet.

3. SIDEWALK REPLACEMENT AND REPAIR

The originals of the field survey forms for areas where inspections have been completed are to be given to the concrete crew by the foreman so that scheduled repairs to all hazard level one's can be completed as soon as possible. Once the hazard level one's are completed, hazard level two's can be checked and monitored. Repairs can be done on these as resources permit.

HAZARD TYPES:	HAZARD RATINGS:	REPAIR TYPES:
1. Cracks or Separations	1. More than 2.5 cm in width 2. 1.25 cm to 2.5 cm in width 3. Less than 1.25 cm in width	1. Remove & Replace 2. Fill
2. Heave or Settlement	1. More than 2.5 cm in height/depth 2. 1.25 cm to 2.5 cm in height/depth 3. Less than 1.25 cm in height/depth	1. Remove & Replace 2. Grind 3. Fill
3. Deflections	1. More than 5 cm change over 1.5 M 2. 2.5 cm to 5 cm change over 1.5 M 3. Less than 2.5 cm change over 1.5 M	1. Remove & Replace 2. Grind Joint 3. Mud Jacking

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SUBJECT: SIDEWALK MAINTENANCE AND INSPECTION

4. Filets	1. More than 5 cm changes over 1.5 M 2. 1.25 cm to 5cm in height/depth 3. Less than 1.25 cm in height/dept	1. Remove & Replace 2. Grind 3. Fill
5. Scaling	1. More than 2.5 cm in depth 2. 1.25 cm to 2.5 cm in depth 3. Less than 1.25 cm in depth	1. Remove & Replace 2. Fill
6. Obstacles	1. More than 2.5 cm in projection/depression 2. 1.25 cm to 2.5 cm in projection/depression 3. Less than 1.25 cm in projection/depression	1. Remove & Replace 2. Grind 3. Fill
7. Other	1. Severe 2. Moderate 3. Low	Define the hazard in the comments section along with your suggested action. Min O/head Clearance = 2.6m Min Width = 1.2m

4. REPAIR OF DAMAGED PROPERTY

Sidewalk maintenance operations may cause property damage even under the best of circumstances and care on the part of maintenance crews. The major types of damage are to improvements in the road right-of-way. The City shall repair/replace sod damaged by sidewalk maintenance. Other damage within the public right-of-way is the responsibility of the property owner including, but not limited to, privately owned trees, shrubs, brushes, landscaping materials, decorative rock, and lawn/landscaping irrigation systems.

5. RECORD RETENTION

As the repairs are completed, the date of repair and who did the repair are to be entered on the field survey form in the appropriate column. The form is then to be turned in to the foreman and forwarded to the front office for filing. Records will be kept in accordance with Municipal Officers Association guidelines.

REASON FOR POLICY: To provide maintenance staff direction on dealing with trip hazards.

LEGISLATIVE AUTHORITY: Council Approval.

PROCEDURE FOR IMPLEMENTATION: Annual Inspection program and service requests.

CITY OF KELOWNA

COUNCIL POLICY MANUAL

APPROVAL DATE:@
RESOLUTION #:@
REPLACING #:N/A
DATE OF LAST REVIEW:@

DRAFT

SUBJECT: SNOW AND ICE CONTROL

3.1.1 General Purpose

This Policy has been prepared to address:

- To maintain roadways and sidewalks in such a manner as to minimize economic loss and inconvenience to the community.
- To prevent or reduce hazardous roadway and sidewalk conditions which may cause accident or injury.
- To facilitate the handling of emergencies by fire, police and ambulance services.
- As a guideline for management and operating personnel in the handling of winter maintenance operations.

3.1.2 Priority System

Applicable To Ice Control, Snow Plowing And Snow Removal Operations

For the purpose of ice control, snow plowing and snow removal operations, the entire street system are assigned to one of three priority classifications. Emphasis of operations shall generally be in order of assigned street classification priority. When necessary, for reasons of safety, at the discretion of the Roads & Equipment Superintendent, or his designate, the order of priority for the provision of the required services may be altered.

On an annual basis prior to September 30, the street priority classification shall be reassessed, by the Roads & Equipment Superintendent or his designate, and revisions made where warranted.

Following the street priority classification review, a map will be prepared reflecting the resolved street classifications. This information will be made available to interested parties upon request.

3.1.3 Ice Control Policy

Anti-icing, sanding and/or de-icing of streets, and in some cases sidewalks, shall be undertaken in order to ensure a reasonable level of safety to motorists and pedestrians as local conditions dictate. Ice control on sidewalks is the responsibility of property owners as per By-Law No. 8120, Section 2.5.1. The City will carry out an in-kind service of plowing sidewalks within resource availability.

Emphasis for plowing operations shall be placed on ensuring that there are no blocked roadways in the city during a major snowstorm and that the major arterial roads within the city are returned to the bare pavement state as soon as possible after the storm. The requirement of plowing operations on residential roadways after these storms shall be at the discretion of the Roads & Equipment Superintendent or his designate. Sanding and/or salting operations will be carried out as per the priority system listed under ice control.

3.1.3.1 Anti-Icing

Anti-Icing will take place on roads as designated by the Roads & Equipment Superintendent.

3.1.3.2 Minor Snow Storms

A minor storm is defined as any storm where we receive less than 10 cm of snow in one event.

a) Priority System of Sanding/Salting Streets

The following description of events shall be implemented in order of priority when in the opinion of the Roads & Equipment Superintendent or his designate, conditions dictate.

Priority #1 - All key points sanded and/or salted within 4 - 8 hours of the completion of a snow storm.

Priority #2 - All key points sanded and/or salted within 6 - 12 hours of the completion of a snow storm.

Priority #3 - All key points sanded and/or salted within 24 - 48 hours of the completion of a snow storm.

b) Priority System of Plowing Streets

The following description of events shall be implemented in order of priority after a minor storm.

Priority #1 - Driving lanes plowed to as close to bare pavement as possible, within 12 - 72 hours.

3.1.3.3 Major Snow Storms

A major storm is defined as any storm where we receive 10 cm of snow or more, or any storm where conditions are such that the Roadways Superintendent or his designate conclude to be a major storm.

a) Priority System of Plowing Streets (Grader Plowing)

The following description of events shall be implemented in order of priority after a major storm.

Priority #1 - Driving lanes plowed to as close to bare pavement as possible, within 12 - 24 hours.

Priority #2 - Driving lanes plowed to compacted snow surface state within 36 – 72 hours.

Priority #3 - Residential streets will only be plowed, using graders, when required for parking or to keep the road passable or at the discretion of the Roads & Equipment Superintendent. Residential lanes will only be plowed if they become impassable.

b) Additional Manpower and Equipment to Combat Major Storms

If, following a major storm, insufficient personnel and equipment are available within the City forces, rented equipment shall be engaged at the discretion of the Roads & Equipment Superintendent or his designate.

3.1.4 Sidewalk Clearing Policy

In accordance with By-Law No. 8120, Section 2.5.1, residence and businesses shall be responsible for the clearing of snow from sidewalks bordering their property within 24 hours of the accumulation of such snow.

Not withstanding the above, the City will provide an in-kind service of attempting to clean all sidewalks within 24 - 72 hours after a storm where we receive a snowfall of 5 cm or more. Sidewalks will be cleared using sidewalk plows and will not be plowed to bare concrete. The occurrence of a second storm will reset the service objective of clearing sidewalks within 24 – 72 hours. The residence or business will still be responsible to ensure all ice has been removed. Sidewalk clearing practices will follow these priorities:

Priority #1 - Sidewalks downtown, sidewalks surrounding City owned property and businesses.

Priority #2 - Sidewalks fronting bus routes, schools and on major arterial that have no residences or businesses abutting them.

Priority #3 - Sidewalks fronting residences.

Ice control on sidewalks will be limited to sidewalks fronting city facilities, roadways where the terrain makes it impossible for development to occur or as directed by the By-Law Enforcement Officer (at property owner's expense).

3.1.5 Snow Removal Policy

Snow removal operations shall be undertaken only in situations where lack of adequate storage prohibits the normal winter movement of vehicular and/or pedestrian traffic and for reasons of safety such as sight restrictions at intersections. During most winter seasons, snow removal will be limited to the main downtown core. Snow Removal priorities will be as follows:

rity #1 - Streets in the downtown area bounded by Harvey Ave. north to Doyle Ave. and
Abbott Street east to Richter Street, as well as the area from Doyle Ave north to Clement Ave and
Water Street to Ellis Street. Locations where sight restrictions have been created by piled snow.

Priority #2 – Pandosy Town Center, Rutland Town Center, Highways #97 and Highway #33.

Priority #3 - Problem windrows of snow at bus stops and school drop-off zones.

3.1.6 Bus Stop Policy

Snow shall be cleared from all Bus Stops immediately following the plowing of the road or sidewalk or at the discretion of the Roadways Supervisor, or his designate.

3.2 PUBLIC RELATIONS

1) All inquiries will be handled by the City Works Yard during normal work hours and the Kelowna Fire Hall after hours, on weekends and holidays.

2) Complaints of an emergency nature are to be transmitted to appropriate field personnel for action.

3) All Media inquiries are to be handled by the Roads & Equipment Superintendent, or his designate.

3.3 OPERATING PROCEDURES

3.3.1 Anti-Icing

a) In order to ensure a reasonable level of safety to motorists and pedestrians this procedure shall be undertaken prior to the arrival of a forecasted snowstorm in accordance with the Weather Event Action Plan.

Anti-icing operations shall be initiated by the Roadways Supervisor, or his designate. Anti-icing shall continue during a storm, at the Roadways Supervisor's discretion until a reasonable level of safety has been attained.

3.3.2 Ice Control By Sanding and Salting

a) In order to ensure a reasonable level of safety to motorists and pedestrians this procedure shall be undertaken as local conditions dictate.

CITY OF KELOWNA

COUNCIL POLICY MANUAL

APPROVAL DATE:@
RESOLUTION #:@
REPLACING #:N/A
DATE OF LAST REVIEW:@

SUBJECT: SNOW AND ICE CONTROL

Sanding operations shall be initiated by the Roadways Supervisor, or his designate, and shall be continued at his discretion until a reasonable level of safety has been attained.

Salting operations shall be undertaken in the downtown core and all Priority 1 roads or other areas with the expressed approval of the Roads & Equipment Superintendent or his designate.

Salting priorities within each area shall be in accordance with the street classifications designated for sanding/salting streets. Within these priority routes, salting shall only take place at the locations listed above. When salting, the entire length of road will be treated.

c) Sanding priorities within each area shall be in accordance with the street classifications designated for sanding/salting streets. Within these priority routes, sanding will only take place at the following locations:

- Street Signalized Intersections
- Stop Signs
- Railroad Crossings
- Street Crosswalks
- Curves
- Hills
- School Zones
- Bus Stops
- Straight Sections (intermittent sanding @ the operators discretion)

Sanding will start at the discretion of the Roadways Stand-by personnel and will continue until the completion of the storm and all Priority 1 & 2's are completed. Priority 3 roads will be completed within 24 hours of the completion of the storm.

The Roadways Supervisor will dictate if conditions call for other areas to be sanded.

d) Materials for ice control operations shall be stockpiled at the City Works Yard.

e) Lengths of areas to be sanded and/or salted are based on calculating stopping distance requirements assuming vehicles are equipped with highway tread tires, a sanded ice surface and a temperature of -1^0 C as follows:

Posted Speed Limits	Length to be Sanded at Intersections
50 kph (30 mph)	61 m (200 ft.)
60 kph (40 mph)	152 m (500 ft.)

CITY OF KELOWNA

COUNCIL POLICY MANUAL

APPROVAL DATE:@
RESOLUTION #:@
REPLACING #:N/A
DATE OF LAST REVIEW:@

SUBJECT: SNOW AND ICE CONTROL

The above table shall apply to the sanding priority #1 and #2 streets. In addition to the above, should the condition of a major street be such that icing is extensive, the whole street shall be sanded.

f) Unless otherwise directed by the Roads & Equipment Superintendent or his designate, the residential roadways (priority #3) shall generally be sanded at street intersections for a length of 15 m (50 ft.) back from the intersection.

All sand/salt will be pre-treated with a liquid de-icer, where mechanically possible.

3.3.3 Snow Plowing

a) In order to provide a reasonable level of safety to motorists and the general public, snow plowing operations shall be implemented as required throughout the winter season.

b) Snow plowing operations shall follow the established priority street program unless otherwise directed by the Roads & Equipment Superintendent or his designate.

c) On an annual basis, prior to September 15, the streets included in each of the priorities shall be re-assessed as to whether or not they should be noted in a higher priority classification. Emphasis shall be given to those areas of high vehicle and pedestrian traffic flow, main arterials and essential service routes and bus routes.

d) By October 1, the City shall prepare a map outlining the various priorities as well as lists outlining the same priorities broken down into individual areas. This information shall be distributed to operating personnel.

e) In order to ensure efficiency in operation, the Roadways Supervisor shall attempt to assign City and hired equipment to designated routes in order that operators become familiar with the areas, thereby increasing efficiency and decreasing damage.

f) The Roadways Supervisor shall implement and co-ordinate a joint effort by all areas in plowing snow on all priority #1 streets. When all priority #1 streets have been completed, the remaining priorities shall be handled by individual areas.

As required, the transfer of manpower and equipment between areas shall be co-ordinated by the Roadways Supervisor, or his designate.

g) If, following a major storm, insufficient personnel and equipment are available in the City work force to meet the snow plowing schedule, private contractor personnel and equipment will be hired.

h) In bus stop locations, an area shall be opened for the loading and unloading of passengers from buses.

i) In designated areas where snow storage is limited, snow ridges will be accumulated along the centre median to be hauled away.

j) On priority #3 roads the travelled portion will be cleared first, with use of underbody snow plows, then as conditions warrant the road will be widened to full width using graders.

ipment

rder to ensure efficiency in operation, the following is used as a guideline and instituted to the extent possible.

- Equipment is utilized to its maximum potential i.e. attempt to discourage use of over-sized loaders where a small loader or hoe can be used to achieve the same results.

- City and hired equipment will be assigned to designated routes, wherever possible, in order that operators become familiar with the areas, thereby increasing efficiency and decreasing damage.

3.3.5 Sidewalk Clearing

a) Sidewalk clearing operations shall be implemented immediately following all storms.

b) After minor or localized snow storms, sidewalk clearing operations shall be implemented at the discretion of the Roadways Supervisor (normally 5 cm).

c) Sidewalk plows shall normally be used for sidewalk clearing operations.

3.3.6 Snow Removal

a) Snow removal shall be undertaken only in situations where lack of adequate storage prohibits the reasonable movement of vehicular and/or pedestrian traffic.

b) Emphasis for snow removal will be according to established priorities.

c) Snow removal will only be carried out on residential streets for reasons of safety at the discretion of the Roads & Equipment Superintendent.

d) Blowers and/or front end loaders will generally be used for the loading of snow from streets

e) Sufficient signage and flag people will be used to ensure the safety of the workers and public as per the Traffic Control Manual for Works on Roadways.

3.3.7 Snow Dump Sites

a) By October 1, the Roadways Supervisor shall confirm proposed snow dump sites with private owners and other City departments. Once confirmed, a list outlining these areas shall be provided to the

operations personnel.

The Roadways Supervisor will ensure adequate drainage at all snow dump sites.

The Roadways Supervisor shall ensure that the snow dump sites, which are only to be used by City equipment, are properly signed in this regard.

d) The Roadways Supervisor shall arrange, at his discretion, for a loader to pile the snow in the dump sites in such a manner that congestion of snow hauling vehicles does not occur.

e) The Roadways Supervisor shall arrange to clear the snow dump sites of accumulated debris as soon as possible following the thawing of the accumulated snow.

3.3.8 City Owned Equipment

a) The Equipment Supervisor shall be responsible for the preparation and overhauling of equipment used in winter maintenance operations according to the following schedule:

Salt & Sand Spreaders	October 15
Sidewalk Plows	October 15
Anti-icing Applicators	November 1
Mounting of Plow Equipment	November 1
Snow Blower	November 1

b) Throughout the winter season, the servicing and repair of all equipment used in winter maintenance operations shall be given priority by the garage.

3.3.9 Standby

The Roadways Supervisor will set up a winter standby shift starting no later than November 1 and ending no earlier March 1. These dates may be changed at the discretion of the Roads & Equipment Superintendent, or his designate. The schedule will be prepared prior to October 1.

CITY OF KELOWNA

COUNCIL POLICY MANUAL

APPROVAL DATE:@
RESOLUTION #:@
REPLACING #:N/A
DATE OF LAST REVIEW:@

SUBJECT: SNOW AND ICE CONTROL

Standby personnel, or his designate, shall do checks of all key areas at appropriate times to allow adequate response of crews before rush hour traffic periods. If slippery conditions are noted sanding and/or snow plowing crews will be called in.

3.3.10 Winter Staff Crew Meeting

The Roadways Supervisor will schedule a crew meeting to review all Snow & Ice procedures and policies,

prior to October 15.

mployees are to take snow and ice control theory training prior to November 1. Each employee will eive practical instruction during the first few snow events. Each employee shall attend the theory ning once every three years.

3.4 E

Completion Date	Activity	Responsibility
September 15	Street Priority Review	Roads & Equip. Supt.
October 1	Prepare Route Maps	Roadways Supervisor
	Designate & Sign Dumpsites	Roadways Supervisor
	Roadways Standby Schedule	Roadways Supervisor
	Garage Standby Schedule	Garage Supervisor
October 15	Winter Staff Crew Meeting	Roadways Supervisor
	Salters & Sanders Ready	Garage Supervisor
	Sidewalk Plows Ready	Garage Supervisor
	Truck Plows Mounted	Garage Supervisor
November 1	Anti-icing Applicators	Garage Supervisor
	Wing Blade Mounts Installed	Garage Supervisor
	Snow Blower Ready	Garage Supervisor
	Employee Training	Roadways Supervisor
November 15	Wing Blades Installed	Garage Supervisor

REASON FOR POLICY: A guideline for management and operating personnel in the handling of winter maintenance operations.

LEGISLATIVE AUTHORITY: Council Approval.

PROCEDURE FOR IMPLEMENTATION: Snow events

The City of Kelowna

SALT MANAGEMENT PLAN

NOTICE:

This Plan is modeled on a Salt Management Plan Template developed by Ecoplans Limited and has been prepared for the sole use of the City of Kelowna. It may not be adapted for use by anyone else without the prior written approval of Ecoplans Limited.

City of Kelowna

MEMORANDUM

To	Our file:
	Your file:
From	Date:

Subject: **SALT MANAGEMENT PLAN**

Attached is your copy of the City of Kelowna's Salt Management Plan for use by staff responsible for roadway and asset maintenance. All staff is responsible for ensuring that effective salt management practices, guidelines and procedures are followed and that services are provided in accordance with the policies outlined in this Plan.

This will ensure the effective winter maintenance for the safety of all roadway users in the City of Kelowna while striving to minimize the amount of salt entering the environment.

John Vos
Director of Works and Utilities

Commitment to the Salt Management Plan

The undersigned are committed to maintaining and implementing the City of Kelowna's Salt Management Plan contained in the document.

SIGNATURE: **DATE:**

Director of Works and Utilities

Roads and Equipment Superintendent

Equipment Supervisor

Roadways Supervisor

Roadways Foreman

Roadways Foreman

Roadways Foreman

TABLE OF CONTENTS

TABLE OF CONTENTS

APPENDICES

INTRODUCTION

INTRODUCTION

Overview

The City of Kelowna has about 1507 lane kilometers of roads within the framework of a classification system, which provide for the safe, efficient and affordable means of surface transportation for road users. People rely on our roadway network throughout the year for transport to the workplace, to recreation and leisure facilities, for the transport of goods and services, and for emergency and security services.

Snow and ice conditions on the road system have a dramatic impact on public safety, roadway capacity, travel time and economic costs. User safety remains a priority within winter maintenance operations, practices and strategies contained in this Salt Management Plan.

Although there is ongoing research into the use of alternatives to road salt in winter maintenance, salt continues to be a cost-effective de-icer. However, because of the adverse effects that salt has on the environment, the Salt Management Plan strives to minimize the amount of salt entering the environment by including best salt management practices, and using new technologies to ensure its most effective use over the road system. At the same time, the City will continue to search out and use viable and cost-effective new technologies and chemicals to reduce the environmental impacts of winter maintenance activities.

In 2001, Environment Canada released an assessment report stating that road salts are entering the environment in large amounts and are posing a risk to plants, animals, birds, fish, lake and stream ecosystems and groundwater. Based on the assessment, Environment Canada determined that a strategy was required to manage the release of road salt into the environment. Environment Canada stated that this management strategy would not include a ban on road salts, but rather will encourage users to develop their own salt management strategy. ***It must be noted that Health Canada stated that road salts are not harmful to humans.***

Health Canada stated that road salts are not harmful to human health.

Environment Canada has released a "Code of Practice for the Environmental Management of Road Salts". Road salt users, that meet the minimum requirements of the Code of Practice, have to prepare a Salt Management Plan to better mange their road salt use and report their progress.

The City of Kelowna has developed this Salt Management Plan in accordance with Environment Canada's Code of Practice for the Environmental Management of Road Salts. This will address growing concerns about the effect road salt is having on our natural environment and at the same time continue to provide for road safety by better managing our use of salt.

Purpose of the Plan

This Plan is intended to set out a policy and procedural framework for ensuring that the City of Kelowna continuously improves the management of road salt used in its winter maintenance operations. The Plan demonstrates the City's commitment to reducing the environmental effects of excessive salt use, consistent with Environment Canada's stated objectives.

Any modifications to winter maintenance activities must be carried out in a way that provides roadway safety and user mobility consistent with the weather conditions experienced during the snow and ice control season.

This Plan is dynamic – allowing the City of Kelowna to phase in new approaches and technologies in a way that is responsive to fiscal demands and the needs to ensure that roadway safety is not compromised.

Legislative Authority

The policies presented in this Plan are consistent with fulfilling the City's obligations under provincial and federal legislation.

City of Kelowna's Vision and Goals

Vision
Kelowna is a vibrant city where the agricultural and beautiful natural setting, community spirit, economic stability and stewardship of the environment enhance the quality of life for residents.

Goals
1. To maintain, respect and enhance our natural environment
2. To foster a strong, stable and expanding economy
3. To foster the social and physical well-being of residents and visitors

Format of the Plan

Chapter 2.0 of this Plan presents the Policy Direction approved by Council.

Chapter 3.0 of this Plan presents the Winter Maintenance Policies that are relevant to salt management.

Chapter 4.0 of this Plan presents the summaries of Operational Practices and Strategies for Snow and Ice Control as they relate to the effective management of road salt. This chapter is presented as a series of sub-section that can be modified as new policies, procedures and practices are introduced and refined.

Chapter 5.0 of this Plan presents the approach to monitoring the implementation of the Plan and to maintaining and updating the Plan.

Responsibilities

Roads and Equipment Superintendent - Has corporate responsibility for the City's Salt Management Plan.

Roadways Supervisor - Responsible for ensuring that the Salt Management Plan is developed, maintained, and implemented consistently across the City. Responsible for overseeing the maintenance and upgrading of the winter maintenance facilities in compliance with the Salt Management Plan.

Equipment Supervisor - Responsible for purchasing, maintaining and calibrating the winter maintenance fleet in compliance with the Salt Management Plan.

Roadways Foreman - Responsible for monitoring the change in environmental impacts associated with the Salt Management Plan. Responsible for ensuring that winter maintenance activities are carried out in compliance with the Salt Management Plan.

Winter Maintenance Personnel – Responsible for ensuring that they carry out their winter maintenance duties in accordance with the policies and procedures set out in the Salt Management Plan as directed by their supervisor.

POLICY

POLICY CONTEXT

In 2002 the City of Kelowna adopted **Kelowna 2020 – Official Community Plan (OCP)**. In the OCP a number of community goals were identified which reflect the desires and aspirations of a broad cross-section of interests across the City. These goals address major aspects of the community -- environmental, social, economic, and governmental. Based on these community aspirations, the series of goals provide the fundamental direction for the Official Community Plan from which future civic initiatives will flow.

OCP Goals
A number of the goals on the OCP have been identified as being relevant to the Salt Management Plan and may have an impact on the Plans development and implementation. The identified goals are:

1. To grow gracefully and in harmony with Kelowna's natural environment;
3. To be wise custodians of our natural environment in order that the lifestyle we enjoy today may be appreciated by future generations;
4. To identify and protect significant natural areas;
5. To prevent deterioration in the quality of water of Lake Okanagan or in the cleanliness of Kelowna's beaches;
12. To provide a range of transportation options for Kelowna residents which are safe, convenient and economically viable; and
17. To continue to provide Kelowna residents with a range of high quality, well managed municipal services.

OCP Chapter 7 - Environment
Chapter 7 of the OCP outlines the City's environmental considerations in a number of areas. Section 9 - Natural Environment Policies outlines an Environmental Management System that may have an impact on the Plans development and implementation, specifically:

9. **Environmental Management System**. Ensure that the management of City activities has the necessary structure and processes to:
   - Identify all aspects of City operations that may have a significant impact on the environment;
   - Manage and control operations and processes to minimize impacts on the environment;
   - Achieve compliance with environmental legislation and regulations;
   - Ensure a defence of due diligence in the event of non-compliance;
   - Continuously improve the City's environmental performance.

The City of Kelowna's Transportation Division's Mandate

The Transportation Division's mandate is to provide a safe, efficient, environmentally-sensitive and cost-effective transportation network which encompasses traffic, pedestrian and cycling planning and construction, roadways management and parking. It also manages the City's equipment fleet. Long-term goals are to protect and enhance the environment, conserve energy and reduce the demand for inefficient transportation such as single-occupant vehicles.

Salt Management Policy

Within the City of Kelowna's overall policy context, the following is the City's policy on the use and management of road salt.

- To comply with all applicable federal and provincial legislation regarding the storage and use of snow and ice control products.

- To use road salt in an environmentally responsible manner, and minimize the negative environmental effects of handling, storage and application of salt on the environment.

- In providing the stated Level of Service, the City of Kelowna will conserve the use of salt by utilizing cost-effective technologies and practices.

Salt Management Principles

1. Road safety is a priority for the City of Kelowna.

2. The use of road salt is essential to maintaining roadway safety during the snow and ice control season.

3. The City of Kelowna will strive to reduce the amount of salt released to the environment through effective salt management practices.

4. The City of Kelowna will share their knowledge and experiences with others.

5. This Salt Management Plan will be updated regularly.

6. The City of Kelowna will provide the necessary training and encouragement to its winter maintenance personnel to allow them to be fully contributing partners in achieving an environmentally sound and safe winter maintenance program.

7. Performance will be measured and reported through appropriate public reporting vehicles.

Implementation Guidelines

This Salt Management Plan was developed in accordance with the following policy directions:

General:

- Salt Management Plans will embrace the concepts set out in the Salt Management Guide (TAC, 1999) and Syntheses of Best Practices (TAC, 2003) prepared by the Transportation Association of Canada and subsequent revisions, and Codes of Practice issued by Environment Canada.

On-roadway Use:

- The City of Kelowna will operate in accordance with clearly stated and documented level of service policies that promote safety and efficient salt use;
- The City of Kelowna will give a priority to salt vulnerable areas when implementing strategies for reducing salt impacts;
- The City of Kelowna will apply salt at rates that are consistent with best salt management practices; and
- The City of Kelowna will strive to improve the efficiency of salt usage through better use of technology and application equipment.

Sand and Salt Storage:

- The City of Kelowna will review current storage practices for salt and sand/salt blends and develop and implement strategies for cleaning up existing sites and minimizing salt loss to the environment from future operations;

Snow Storage & Disposal:

- The City of Kelowna will carry out environmental reviews of snow storage areas to improve site selection and management of practices that impact the environment, including site drainage; and
- The City of Kelowna will manage its snow disposal sites in a way that minimizes impacts to the environment.

Training:

- The City of Kelowna will implement effective employee training and awareness for supervisors and operators.

Decision-Support:

- The City of Kelowna will strive to increase staff focus on pavement temperatures; and
- The City of Kelowna will strive to monitor and interpret weather forecasts.

Record Keeping:

- The City of Kelowna will strive to improve record keeping to enable better tracking of salt use and salt-related impacts; and
- The City of Kelowna will develop salt management performance criteria and related monitoring program. These will be integrated into any national salt management reporting program developed by Environment Canada.

Application

This policy was adopted by City Council on _____ and applies to all employees and contractors involved in Winter Maintenance Operations for the City.

Implementation

This Salt Management Plan is activity based and follows an Environmental Management System framework. It includes the following elements:

- Periodic review and analysis of industry practices
- Implementation and documentation of the Plan
- Education and training of staff
- Monitoring and analysis of operations
- Management review and revisions
- Environmental review
- Policy and practices revision

The implementation and improvement of this Salt Management Plan will promote the continuous development of practices and procedures to improve winter maintenance activities and procedures while striving to reduce the effects of road salt on our environment. The Plan is a dynamic document. It will be reviewed and refined on an on-going basis and embraced at all levels of the organization. All personnel are responsible for ensuring that this Plan is implemented, monitored, improved and updated.

Managers are encouraged to negotiate adoption of the policies and procedures in this Plan by other parties involved in snow and ice control activities including:

- private operators; and
- general contractors.

WINTER MAINTENANCE STANDARDS

WINTER MAINTENANCE STANDARDS

Introduction

This chapter documents the City's snow and ice control standards.

The major activities related to winter maintenance are:

- salt and sand storage;
- salt spreading;
- sand spreading;
- snow plowing; and
- snow removal and disposal.

Level of Service Policy

For the purpose of ice control, snow plowing and snow removal operations, the entire street system for the City of Kelowna has been assigned to one of three priority classifications. Emphasis of operations shall generally be in order of assigned street classification priority. When necessary, for reasons of safety, at the discretion of the Roads and Equipment Superintendent, or his designate, the order of priority for the provision of the required services may be altered.

The street classification priorities are reviewed on an annual basis, before September 15, by the Roads and Equipment Superintendent.

The City's Level of Service (LOS) is defined in a Council Policy as documented in Chapter 3 of the "City of Kelowna Snow and Ice Control Training Manual".

The LOS is designed to meet the needs of the community from the perspective of driver safety and the provision of emergency service. The LOS is driven by both the technical requirements of winter operations and the need to address the socio-economic concerns of an urban municipality.

Material Application Rates

Salt

Salt is currently used as a de-icer in a reactive response to the build up of ice. Salt is generally applied when temperatures are -6^{o}C and above to priority 1 and sometimes priority 2 roads. A heavy salt application combined with plowing is used at times for temperatures below -6^{o}C. A single application rate for salt has been defined in the policy however; other application rates are used operationally and not documented in the Snow and Ice Training Manual. For heavy snowfalls and ice accumulations a calculation is done to determine the amount of salt required to melt the ice and the application rate is set accordingly.

Table B.1 in Appendix B summarizes the typical operational application rates used for salt. As application rates for salt are refined and adjusted the rates will be adjusted in Table B.1.

Salt is usually applied with on-board pre-wetting[1] using Sodium Chloride brine or Magnesium Chloride brine for colder temperatures. Liquid application rates for pre-wetting have been defined in the Snow and Ice Control Training Manual and are summarized in Table B.3 of Appendix B. As on-board pre-wetting application rates are refined, the rates will be adjusted in the table.

Some Magnesium Chloride flake is used from time to time as a deicer for colder temperatures, particularly at the transit mall with its large volume of exposed concrete.

Operators are to apply salt at the rate specified by the foreman. They are allowed limited control regarding frequency and timing of salt applications for frost control.

Abrasives

A mixture of sand and road salt (sand/salt blend) is used as an abrasive to improve traction, and provide some ice and snow control at times, on City roads. It is generally only applied at intersections and other potentially hazardous areas on priority 1 and 2 roads. Sand and salt are purchased and delivered to the yard. Sand is stored outside. Staff blend salt with the sand at approximately 20% by volume and stockpile it in a shed.

A single application rate is stated in the Snow and Ice Control Training Manual. Table B.2 in Appendix B presents a summary of the current operational application rates for abrasives for various conditions requiring traction improvement or snow and ice control that occur within the City. As application rates are refined the rates in the table will be adjusted.

Sand/Salt blend is usually applied with on-board pre-wetting[1] using Sodium Chloride brine or Magnesium Chloride brine for colder temperatures. Liquid application rates for pre-wetting have been defined in the Snow and Ice Control Training Manual and are summarized in Table B.3 of Appendix B. As on-board pre-wetting application rates are refined, the rates will be adjusted in the table.

Operators are to apply salt at the rate specified by the foreman. They are allowed limited control regarding frequency and timing of salt applications for frost control.

Liquids

The City has an extensive and well defined anti-icing[2] program using primarily Magnesium Chloride brine in a direct liquid application (DLA) on City roads. The City also uses Sodium Chloride brine and some Magnesium Chloride brine at colder temperatures for on-board pre-wetting of both salt and abrasives. The City produces its own Sodium Chloride brine and has a contractor deliver the Magnesium Chloride brine.

[1/] **On-board pre-wetting** is the application of a liquid to a solid material just prior to application to the road surface. Applying a liquid to the solid material helps the solid material "stick" to the road surface and not bounce away onto the shoulder. Liquid applied to a solid chemical also begins the process of brine formation and allows the chemical to act quicker.

[2/] **Anti-icing** is a proactive snow and ice control strategy whereby straight brine is sprayed directly on the road in advance of a storm. The term can also refer to early application of chemical in any form early in a storm to prevent the formation of the snow/road bond.

Application rates for both anti-icing and on-board pre-wetting are defined in the Snow and Ice Control Training Manual and are summarized in Table B.3 of Appendix B. As anti-icing and on-board pre-wetting application rates are refined, the rates will be adjusted in the table.

Snow Removal, Storage and Disposal

As a result of snow plowing operations, snow accumulates at the side of roads as windrows. In most cases this is not a concern. However in some locations where snow storage is a problem, the accumulated snow must be removed. Snow removal operations are started when windrows reach volumes that create a nuisance or hazard to pedestrians and motorists, or to maintain capacity for subsequent snowfalls. Snow disposal must be handled properly to ensure that the operations do not cause adverse effects to the environment.

The City loads, hauls and disposes in the range of 300 truck loads of snow each season. The City has 5 snow storage and disposal sites available for use:

- A vacant 20 acre lot surrounded by roads, residential and a recreational area. Used as overflow parking for the rest of the year. Most of the meltwater infiltrates into the ground with little offsite surface runoff. Only site used during the 2004/2005 season.
- An asphalt parking lot beside a lake surrounded by commercial property. Meltwater flows into catch basins and into the City's stormwater system.
- An empty lot near the transit garage surrounded by a railway and road. The meltwater infiltrates into the ground. Used for stockpiling fill material during the summer and fall.
- An empty field used as a dog run, surrounded by open land and roads. The meltwater infiltrates into the ground.
- A vacant lot (formally a residential lot) surrounded by residential and a hayfield. The meltwater infiltrates into the ground.

The sites have not been engineered or improved in any way. Litter is picked up and the sites are cleaned each spring. The City has a documented Snow Removal, Storage and Disposal Policy and Guidelines for snow storage and disposal sites and snow loading and hauling operations.

Sidewalk, Pedestrian Crossings, Bus Stops and Parking Lot Snow Clearing

Residences and businesses are responsible for clearing snow and ice from sidewalks fronting their property. The City provides an in-kind service of plowing accumulated snow in excess of 5 cm from all City sidewalks within 24 hours after the completion of a snowstorm. Ice control using Magnesium Chloride flake when needed is limited to sidewalks fronting City property. Bus stops and pedestrian crossings are cleared at the same time the sidewalks are. Snow is loaded and hauled to the snow storage and disposal sites as needed.

The Parks and Leisure Services Department is responsible for the municipal parking lots at city facilities. Transportation is responsible for all paid parking lots that are not part of a park or city facility. Plowing of the parking lots is contracted out. Straight sand and/or Sodium Chloride are applied as needed by City crews. Accumulated snow is loaded and hauled to the snow storage and disposal sites as needed by City crews.

OPERATIONAL PRACTICES & STRATEGIES

OPERATIONAL PRACTICES AND STRATEGIES

Overview

This chapter of the Plan presents a discussion of each of the key operational practices and strategies related to the effective management of road salt during winter maintenance activities.

Each subsection has a summary that presents a discussion of the objectives, environmental considerations, current situation, best practices, action plan, responsibilities, performance measures and references (documents or tables). Table 4.1.1 explains the intent of each category.

It is important to recognize that the Plan is dynamic and will take time to implement. Therefore, the purpose of this section is to establish the goals (Salt Management Best Practices) of the Plan and a strategy (action plan) for achieving these goals.

TABLE 4.1.1

SUBJECT			
OBJECTIVE	This section states the salt management objective that is to be achieved.		
ENVIRONMENTAL CONSIDERATION	It is important that people understand the rationale behind the need to make changes. This section identifies briefly the environmental considerations that make it important to address the subject area.		
CURRENT SITUATION	This section identifies the status of the subject area at the time of initial implementation of the Plan or following any update of the Plan.		
BEST PRACTICE	This section identifies the Best Practices for each subject area.		
ACTION PLAN	ACTION	DATE	WHO
	Planned actions to address the gaps.	Target date	Who has responsibility to take the action
	Continuation of current best practices.	Ongoing	
IMPLEMENTATION CONSIDERATIONS	Explanation of reasoning behind the action plans and target dates factoring in resource issues. Also consider opportunities such as partnerships.		
PERFORMANCE MEASURE	It is important to monitor and measure the progress of implementing each element of the salt management Plan. This section will establish the criteria for measuring performance. There should be a performance criterion for each action plan.		
REFERENCES	This section identifies any reference documents or tables related to this element of the Plan or that provide more detailed direction regarding implementation of the salt management strategy.		

Note: In the Responsibilities sections below:
R&E Superintendent refers to – **Roads & Equipment Superintendent**
RW Supervisor refers to – **Roadways Supervisor**
RW Foreman refers to – **Roadways Foreman**
Eq. Supervisor refers to **– Equipment Supervisor**

Management Practices

Level of Service

LEVEL OF SERVICE

OBJECTIVE	To ensure that the Level of Service (LOS) policy is reviewed and that any revisions are approved by senior management and communicated to winter maintenance personnel. The LOS policy must be clear, functional and understandable to operations personnel and the layperson (e.g. public and politicians). It should make it clear what is to be achieved and what will not be achieved (e.g. there may not be continuous bare pavement conditions throughout a storm). Typically the LOS policy will explain the intended: ▪ Initial response time; ▪ Cycle frequency; and ▪ End of storm condition.		
ENVIRONMENTAL CONSIDERATION	The prescribed level of service is the foundation for the winter maintenance program and has a significant impact on salt used to achieve the standard. It is also very important in being able to demonstrate due diligence in the event of a claim against the road authority.		
CURRENT SITUATION	• Each road in the City's network has been classified into one of three priorities. • The road priorities are reviewed each summer and updated as needed. • The City's Level of Service (LOS) is documented in the Snow and Ice Control Training Manual and has been approved by City Council for budget and staffing purposes. See Appendix A for a version history of the Training Manual. • The LOS reviewed during training each fall and updated as needed.		
BEST PRACTICE	A documented and approved LOS policy exists and is followed by all snow and ice control personnel that includes: ▪ Response requirements; ▪ Cycle time requirements; and ▪ End of storm condition.		
ACTION PLAN	• Continue to review the road priorities, LOS and Training Manual annually and update as needed.	Ongoing	RW Supervisor
	• Consider the potential impacts of introducing new technologies.	Ongoing	RW Supervisor
	• Take the current policy to Council for adoption.	2006	R&E Superintendent
	• Obtain management and Council endorsement of the revised road priorities and LOS policy.	Ongoing	R&E Superintendent
	• Implement the revised policy.	Ongoing	RW Supervisor
ACTION PLAN (continued)	• Inform staff, management and the public on the intentions and expectations in service delivery.	Ongoing	R&E Superintendent
	• Monitor and report on compliance with the LOS policy annually.	Ongoing	Roadways Foreman
IMPLEMENTATION CONSIDERATIONS	Changes in LOS expectations will impact the cost of service. For example, if you increase the cycle time, you may decrease the equipment needs, which reduces cost.		
PERFORMANCE MEASURE	• Adoption by Council of current policy. • Completion of a review or revision of the road priorities and LOS policy. • Presence of a written LOS policy that has been endorsed by senior staff. • Compliance with the LOS policy throughout the organization.		
REFERENCE	Refer to LOS and Application Rate Policies.		

Equipment

Good salt management is dependent upon having equipment that permits operators to place:

- the **right material**;
- at the **right time**;
- at the **right amount**;
- in the **right place**; and
- **keep it there** long enough to do the job.

Proper equipment is also important for tracking salt usage and being able to measure progress in reducing excessive salt use.

Effective annual calibration along with ongoing monitoring and recalibration are important equipment maintenance practices.

Technologies such as ground-speed oriented electronic controllers with data loggers and variable spreader settings can improve salt use. Techniques such as pre-wetting and anti-icing are also proven methods for reducing salt use.

Spreaders need to be washed to prevent corrosion. However, improper management of washwater can lead to environmental impacts.

The following action plans relate to fleet allocation, upgrading and maintenance.

Fleet Allocation/Optimization

Fleet Allocation/Optimization			
OBJECTIVE	To optimize the use of spreaders and plows by efficient routing in accordance with the LOS expectations.		
ENVIRONMENTAL CONSIDERATION	Duplication of service due to inefficient routes leads to redundant salt use and premature plowing of previously salted roads.		
CURRENT SITUATION	• No computerized winter maintenance route optimization has been done for the City. • Staff review routes every year and the equipment has been placed on the most appropriate routes.		
BEST PRACTICE	• Routes are periodically reviewed to ensure that equipment is allocated for optimal snow and ice control and salt use.		
ACTION PLAN	• As new technologies are implemented, LOS is changed, new development is added or road priorities adjusted, affected spreader, plow and anti-icing routes will be reviewed.	Ongoing	R&E Superintendent
	• Assess the need for computerized route optimization.	2006	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• The timing of implementing route optimization is contingent upon the availability of equipment. • There will be costs associated with acquiring new equipment. • There will be facility implications. • The City will reassign Winter Maintenance Personnel including contractors as required. • There is an ongoing need for route refinements.		
PERFORMANCE MEASURE	• Completion of reviews of routes. • Achievement of the LOS for each class of road.		
REFERENCE			

Fleet Upgrading

ELECTRONIC SPREADER CONTROLS			
OBJECTIVE	To equip all spreaders with electronic spreader controls that can be accurately calibrated, regulated to ground speed and will generate pertinent salt-use data.		
ENVIRONMENTAL CONSIDERATION	Electronic controllers ensure that the chosen and prescribed amount of salt is being placed on the roadway consistently, regardless of speed and provides data that permits salt use to be tracked.		
CURRENT SITUATION	• The City has 10 units used to apply abrasives and salt. Five of the units (50%) have electronic controls. • The City has 2 units used for anti-icing and they have electronic controls. • Data from the electronic controls is retrieved after each event, reviewed and archived. • The City does not have an AVL/GPS[3] system.		
BEST PRACTICE	• All equipment used to spread winter control materials (solid and liquid) is outfitted with groundspeed regulated electronic controllers with data loggers, downloading capabilities and the ability to communicate with AVL/GPS[3] equipment. • Material application data from each event, at the truck or route level, is logged, retrieved, reviewed and archived.		
ACTION PLAN	• All City owned spreaders used to apply abrasives, salt and liquids shall have electronic controllers with data storage and retrieval capabilities.	2010	R&E Superintendent (to review timing) Eq. Supervisor (to implement)
	• Investigate options for improving contractor equipment.	2006	R&E Superintendent
	• Implement an AVL/GPS[3] system and integrate it with the electronic controllers.	2007	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Where possible move towards consistency within the fleet. Recognize that some variability will always exist between new and older equipment and future technological improvements. • Budget constraints and delivery schedules for new equipment will affect the pace of the fleet upgrades.		
PERFORMANCE MEASURE	• Percentage of material application units with electronic controllers. • Percentage of salt spread with units with electronic controllers. • Percentage of brine spread with units with electronic controllers.		
REFERENCE			

[3] Automated Vehicle Locating system using the Global Positioning System.

PRE-WETTING AND ANTI-ICING EQUIPMENT			
OBJECTIVE	To improve the effectiveness of salt applied to roadways through the use of pre-wetting of sand and/or salt, and anti-icing techniques.		
ENVIRONMENTAL CONSIDERATION	Pre-wetting of materials helps to keep the material on the roadway by reducing bounce and blowing and activates the salt more quickly. Studies show that the actual amount of rock salt applied can be reduced when pre-wetting and that pre-wetted abrasives will stay on the road longer to provide traction. Significant reductions in salt use can also be achieved through the use of liquid anti-icing – especially during the fall and spring for frost and black-ice conditions.		
CURRENT SITUATION	• The City has 10 units used to apply abrasives and salt. 8 of the units (80%) have pre-wetting capabilities. • Contractors provide 9 spreaders with pre-wetting. • The City has two units for anti-icing. • The City has documented procedures and application rates for pre-wetting and anti-icing.		
BEST PRACTICE	• An optimum number of spreaders have on-board pre-wetting capabilities. • Secure liquid supplies are available. • Anti-icing is carried out where warranted. • Fixed Automated Spray Technology (FAST) systems are used where cost-effective. • Staff is knowledgeable in the use and handling of liquids.		
ACTION PLAN	• Ensure that the optimum amount of equipment used to apply material has pre-wetting capabilities.	Ongoing	Eq. Supervisor
	• Ensure staff is knowledgeable in liquid use and handling.	Ongoing	RW Supervisor
IMPLEMENTATION CONSIDERATIONS	• Where possible move towards consistency within the fleet. Recognize that some variability will always exist between new and older equipment and future technological improvements. • Budget constraints and delivery schedules for new equipment will affect the pace of the fleet upgrades.		
PERFORMANCE MEASURE	• Percentage of abrasive and salt spreaders with pre-wetting capabilities. • Number of units capable of anti-icing. • Percentage of staff knowledgeable in liquid use and handling.		
REFERENCE			

Equipment Maintenance and Calibration

SPREADER CALIBRATION			
OBJECTIVE	To ensure that equipment is properly calibrated at the beginning of the snow and ice control season and that the calibration is checked and maintained during winter.		
ENVIRONMENTAL CONSIDERATION	Effective placement of salt depends on accurate calibration of spreaders.		
CURRENT SITUATION	• All units used to apply material are calibrated each fall. • Calibration is the responsibility of the Roadways & Garage Staff. • Calibration procedures are documented and all calibration records are kept and reviewed.		
BEST PRACTICE	• All spreaders are calibrated before the start of each season and checked and recalibrated whenever they go out of calibration.		
ACTION PLAN	• All equipment used to apply material will be properly calibrated (including material rate of application) prior to each season.	Ongoing	Eq. Supervisor
	• A calibration history for all spreaders will be maintained and reviewed annually.	Ongoing	Eq. Supervisor
	• Benchmark all routes (determine the quantity of material applied at a given application rate) to ensure that the correct amount of material is being applied. Material applied will be periodically checked against the benchmark to verify calibration. Equipment would then be recalibrated as required.	2006	RW Supervisor & Eq. Supervisor
	• Equipment will be recalibrated after any repair that affects the material delivery system.	Ongoing	Eq. Supervisor
IMPLEMENTATION CONSIDERATIONS	• There are limitations to the calibration process, which introduce minor errors. • The calibration procedure should identify when a calibration review will occur. • It is important to acknowledge that a degree of tolerance is acceptable. • Staff availability, weather and seasonal changeovers can affect calibration schedules.		
PERFORMANCE MEASURE	• Percentage of spreaders calibrated prior to each winter season. • Number of re-calibrations carried out during each winter.		
REFERENCE			

Equipment Washing

EQUIPMENT WASHING	
OBJECTIVE	To ensure that equipment washwater is managed in a way that minimizes discharges to the environment.

ENVIRONMENTAL CONSIDERATION	It is not possible to contain the chlorides unless collected in a tank. Vehicle washwater contains de-icing chemicals, oil, grease and grit. If allowed to discharge to ditches or within the yards and camps these contaminants can have adverse effects on the environment.		
CURRENT SITUATION	• Spreaders are generally washed as time and weather conditions permit. • Vehicle washing is carried out both indoors and outdoors. • The washwater from indoor washing is directed to an oil/grit/water separator and discharged to the sanitary sewer. • The washwater from outdoor washing is directed to an oil/grit/water separator and to ground infiltration. • Contractors do, at times, use the outside wash bay. • The City does not have a Washwater Management Policy or Guidelines.		
BEST PRACTICE	• Washwater is collected and sent for proper disposal where possible. • Equipment is swept dry prior to washing. • Washwater is sent to municipal treatment where possible.		
ACTION PLAN	• Investigate and, if needed, implement options for additional washwater management	2006	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Containment and disposal has a cost. • Contaminant levels may prohibit use in brine production.		
PERFORMANCE MEASURE	• Development and implementation of a washwater management guideline. • Percentage of sites with washwater management facilities that are consistent with the guideline.		
REFERENCE			

Materials

Material Ordering, and Delivery

MATERIAL ORDERING AND DELIVERY			
OBJECTIVE	To ensure that the quality of the snow and ice control materials delivered is sufficient for winter maintenance needs.		
ENVIRONMENTAL CONSIDERATION	Improper handling and storage of salt and treated sand can increase loss to the environment. Excessive moisture creates clumping of the salt making salt difficult to use. Excessive moisture also interferes with the success of pre-treatment operations.		
CURRENT SITUATION	• The City has specifications for sand and salt. • The City follows the PNS specifications for delivered liquids. • The City manufactures its own Sodium Chloride brine to a 21% solution (Training Manual Page 16 - 4.2.6). • Material is not test against the specifications upon delivery. • Bulk sand is delivered outdoors and is left exposed. • Staff blend the sand and salt and stockpile it in a shed. • Salt is unloaded directly into the storage shed. • Deliveries are logged and reconciled with usage at year end.		
BEST PRACTICE	• Materials are tested, delivered and stored in a way that ensures they meet the specifications and are covered immediately upon delivery.		
ACTION PLAN	• Review and update material specifications in light of potential changes in material ordered, storage facilities and application technologies.	Ongoing	RW Supervisor
	• Ensure delivered bulk material is tested periodically and meets the specifications.	Ongoing	RW Foreman
	• Review the City's Brine production to ensure an optimal liquid is being produced.	Ongoing	RW Foreman
IMPLEMENTATION CONSIDERATIONS	• Have a contingency plan for when salt cannot be placed under cover immediately.		
PERFORMANCE MEASURE	• Summary of quality tests for materials. • Percentage of deliveries that do not meet specifications.		
REFERENCE			

Material Application Rates

MATERIAL APPLICATION RATES			
OBJECTIVE	To optimize the amount of chemical, liquid and sand used in winter maintenance operations.		
ENVIRONMENTAL CONSIDERATION	Any opportunity to reduce the amount of salt and blended sand used will reduce the amount of salt entering the environment, provided that road safety is not compromised.		
CURRENT SITUATION	• An abrasive and salt application rate are suggested in the Training Manual (stated in Kg / Lane Km). A range of rates are used operationally up to 224 kg / 2 lane km for salt and 562 kg / 2 lane km for abrasives. • The Training Manual suggests salt is ineffective below -6^{o}C and that a sand/salt blend should be used. Operationally a high application rate of salt is used if the temperatures are -6^{o}C and falling. • Pavement or surface temperatures are only mentioned in relation to liquid application rates in the Training Manual. • Liquid application rates for pre-wetting and anti-icing are well defined in the Training Manual. • The application rates are summarized in the tables in Appendix B.		
BEST PRACTICE	• Application rates for all materials are specified and documented. • Application rates are adjusted for pavement temperatures and precipitation types. • Application rates are reviewed and adjusted, as new technologies and information become available.		
ACTION PLAN	• Review and update the documented application rates for abrasives and salt. Consider reducing the high application rate for salt.	2006	RW Supervisor
	• Ensure application rates are adjusted for pavement temperatures and precipitation types.	Ongoing	RW Foreman
	• As new technologies and materials are introduced and experience grows review and update the material application rates.	Ongoing	RW Supervisor
	• Review anti-icing application rates using NaCl brine and merits of increased use.	2005	RW Supervisor
	• All operators shall be knowledgeable in the approach adopted.	Ongoing	RW Supervisor
IMPLEMENTATION CONSIDERATIONS			
PERFORMANCE MEASURE	• Material application rates reviewed or updated. • Tonnes of salt applied through spreading operations. • Litres of brine applied through spreading operations.		
REFERENCE			

Sand/Salt Blends

SAND/SALT BLENDS			
OBJECTIVE	To optimize the amount of salt in sand/salt blends required to ensure the abrasives function effectively in snow and ice control.		
ENVIRONMENTAL CONSIDERATION	Only enough salt should be added to abrasives to keep the abrasives free flowing under freezing conditions. In some cases, higher sand/salt blends are used to address special circumstances. High amounts of salt in sand/salt blends can result in excessive salt entering the environment for the task. The concept of sand aiding the retention of straight-salt on the road can increase the silt and dust produced.		
CURRENT SITUATION	• Blended sand is used to provide traction and provide some snow and ice control on the City road network. • Sand is blended with NaCl at a rate of approximately 20% by volume and stockpiled indoors. • The Training Manual discusses the use of sand/salt blends from 5% to 25%. • Operationally sand/salt blends are used when temperatures are below -12°C.		
BEST PRACTICE	• Sand/salt blends are only used to improve traction. • High percentage salt/sand mixes are only used in limited situations. • Salt is limited to 3-5% in sand/salt blends to prevent freezing.		
ACTION PLAN	• To limit the amount of salt in stockpiled sand/salt blend to a maximum of 5% by volume to prevent freezing of the sand.	Ongoing	Roadways Foreman
	• To move toward a better method for creating sand/salt blends to achieve a more thorough mixing.	2006	R&E Superintendent
	• Review and update the Training Manual to reflect the operational use of abrasives.	Ongoing	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• A cross-Canada TAC survey identified the best practice trend to minimize the amount of salt blended with sand. There may be cultural adjustments needed to prevent operators from sweetening the load. • Minimal salt/sand ratios require thorough blending with dry sand.		
PERFORMANCE MEASURE	• Percentage of salt in sand/salt blends. • Tonnes of sand used.		
REFERENCE			

Material Storage / Handling

SALT STORAGE / HANDLING	
OBJECTIVE	All snow and ice control chemicals shall be stored and handled inside proper storage structures so as to minimize loss of salt to the environment.
ENVIRONMENTAL CONSIDERATION	If not properly stored, de-icing chemicals can be lost to the environment in large quantities because of exposure to precipitation and wind. This loss can be costly due to the actual loss of salt, and can lead to environmental damage.

CURRENT SITUATION	• Salt is delivered loaded directly into a shed with a concrete pad and no door. • Drainage around the shed is not controlled and drains away overland. • Vehicles are generally loaded a few hours ahead of a storm. • Vehicle loading takes place outside on a gravel surface. • Salt handling and loading procedures are documented. • Salt usage is tracked manually by operator estimates and logged on a Time Resource Management (TRM) form. The data from the electronic controllers is also retrieved after each event, reviewed and archived. • Usage is reconciled with deliveries at year end.		
BEST PRACTICE	• 100% of salt is stored indoors on impermeable floors immediately upon delivery to the site. • Storage structures are properly maintained to control loss of salt through the floors. • Storage structures have doors or overhangs to minimize precipitation entering the structure. • Storage facilities are large enough to provide for indoor unloading of materials and loading of spreaders. • Outdoor salt handling areas are paved. • Salt impacted site drainage is collected and used in brine production or sent for disposal. • Materials are reconciled at the end of the year.		
ACTION PLAN	• All salt will be stored indoors on an impermeable pad not exposed to the elements.	Ongoing	RW Foreman
	• Any new salt storage facilities will be designed with regard to the principles set out in TAC's Syntheses of Best Practices Road Salt Management.	Ongoing	R&E Superintendent
	• Consider recycling the drainage water into brine production.	2007	R&E Superintendent
ACTION PLAN (continued)	• The data from the electronic controllers will be retrieved, reviewed and archived after each event.	Ongoing	RW Foreman
	• The salt loading area shall be paved and include an appropriate drainage water management system. Investigate the merits of an evaporation system.	2007	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• The size and timing of pilot projects will depend upon a reliable source of salt being available in the short term. • The timing for the installation of the drainage water management systems is tied to the timing of material storage installations. • There are safety considerations related to venting structures when loading salt indoors. • Yard rationalization may impact the phase-in timing.		
PERFORMANCE MEASURE	• Number of new storage facilities designed with regard to the principles set out in TAC's Syntheses of Best Practices Road Salt Management - Design and Operation of Road Maintenance Yards • Percentage of salt used that was stored in covered storage facilities. • Percentage of salt storage facilities that have drainage water management systems.		

REFERENCE	TAC's Syntheses of Best Practices Road Salt Management - Design and Operation of Road Maintenance Yards.

BLENDED SAND STORAGE / HANDLING			
OBJECTIVE	All blended sand shall be stored and handled so as to minimize loss to the environment.		
ENVIRONMENTAL CONSIDERATION	If not properly stored, snow and ice control chemicals in blended sand can be lost to the environment in large quantities because of exposure to precipitation which dissolves it out of the exposed pile. This loss can be costly due to the actual loss of salt, and can lead to environmental damage.		
CURRENT SITUATION	• Sand is delivered and stockpiled outside. • Staff blend the sand and salt and stockpile it in a shed with a concrete floor and no door. • Drainage around the shed is not controlled and drains away overland. • Vehicles are generally loaded a few hours ahead of a storm. • Vehicle loading takes place outside on a gravel surface. • Blended sand handling and loading procedures are documented. • Blended sand usage is tracked manually by operator estimates and logged on a Time Resource Management (TRM) form. The data from the electronic controllers is also retrieved after each event, reviewed and archived. • Usage is reconciled with deliveries at year end.		
BEST PRACTICE	• All blended sand is stored indoors on impermeable floors immediately upon delivery to the site. • Storage structures are properly maintained to control loss of salt through the floors. • Storage structures have doors or overhangs to minimize precipitation entering the structure. • Storage facilities are large enough to provide for indoor unloading of materials and loading of spreaders. • Outdoor handling areas are paved. • Salt impacted site drainage is collected and used in brine production or sent for disposal. • Materials are reconciled at the end of the year.		
ACTION PLAN	• All blended sand will be stored indoors on an impermeable pad not exposed to the elements.	Ongoing	RW Foreman
	• Any new blended sand storage facilities will be designed with regard to the principles set out in TAC's Syntheses of Best Practices Road Salt Management - Design and Operation of Road Maintenance Yards.	Ongoing	R&E Superintendent
	• The data from the electronic controllers will be retrieved, reviewed and archived after each event.	Ongoing	RW Foreman
ACTION PLAN (continued)	• The blended sand loading area shall be paved and include an appropriate drainage water management system. Investigate the merits of an evaporation system.	2007	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Staff needs to be conscientious in keeping the blended sand pile pushed back from the structures' doorway.		

PERFORMANCE MEASURE	• Percentage of blended sand stored indoors on impermeable pads. • Number of new storage facilities designed with regard to the principles set out in TAC's Syntheses of Best Practices Road Salt Management - Design and Operation of Road Maintenance Yards. • Percentage of blended sand storage facilities that have drainage water management systems.
REFERENCE	TAC's Syntheses of Best Practices Road Salt Management - Design and Operation of Road Maintenance Yards

LIQUID STORAGE / HANDLING			
OBJECTIVE	All liquid snow and ice control chemicals shall be stored and handled inside proper storage systems so as to minimize loss of liquid to the environment.		
ENVIRONMENTAL CONSIDERATION	If not properly stored or handled, liquid chemicals can be lost to the environment in large quantities very quickly. This loss can be costly due to the actual loss of material and the materials ability to quickly move into the environment, and can lead to environmental damage.		
CURRENT SITUATION	• The City purchase Magnesium Chloride brine and has storage for approximately 42,000 litres. The City produces its own Sodium Chloride brine and has storage for approximately 21,000 litres. • The Sodium Chloride brine is primarily used for pre-wetting salt and blended sand. The Magnesium Chloride brine is used for anti-icing. • The building, the tanks are in, acts as a secondary containment system in the event of a spill or tank breach. • Procedures for producing, storing and handling liquids are documented. • The Training Manual indicates that the Sodium Chloride brine is to be produced as a 21% or less salt solution.		
BEST PRACTICE	• Liquid storage tanks and production areas have spill containment. • Outdoor liquid handling areas are paved. • Salt impacted site drainage is collected and used in brine production or sent for disposal. • Materials are reconciled at the end of the year. • Staff is knowledgeable in the use and handling of liquids.		
ACTION PLAN	• Any new liquid storage facilities will be designed with regard to the principles set out in TAC's Syntheses of Best Practices Road Salt Management.	Ongoing	R&E Superintendent
	• All liquid storage facilities shall have drainage water management systems.	2006	R&E Superintendent
	• Ensure staff is knowledgeable in the use and handling of liquids.	Ongoing	RW Supervisor
	• Review and update the Training Manual to reflect the operational production of liquids.	Ongoing	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Staff needs to be aware of the proper handling procedures for liquids as they differ significantly from traditional solid material handling.		
PERFORMANCE MEASURE	• Percentage of liquids used that were stored in tanks with proper secondary containment for spills. • Number of new liquid storage facilities designed with regard to the principles set out in TAC's Syntheses of Best Practices Road Salt Management - Design and Operation of Road Maintenance Yards.		
REFERENCE	TAC's Syntheses of Best Practices Road Salt Management - Design and Operation of Road Maintenance Yards.		

Good Housekeeping Practices for Maintenance Yards

GOOD HOUSEKEEPING PRACTICES

OBJECTIVE	To ensure that practices at salt storage and handling facilities are geared toward reducing salt loss to the environment.		
ENVIRONMENTAL CONSIDERATION	Improper handling of salt at maintenance facilities can result in significant amounts of salt being lost to the environment. Good housekeeping practices can help to reduce this loss.		
CURRENT SITUATION	• City staff and contractors are to follow all Health and Safety Regulations, the City of Kelowna Safety Program and their Operators Manual. • The facilities are inspected each fall and spring and repairs are done as needed. • Good Housekeeping Practices are managed by the Roadways Foreman.		
BEST PRACTICE	• A Good Housekeeping Policy is documented and implemented at all yards and practices are periodically audited.		
ACTION PLAN	• Update the Good Housekeeping Practices to include Salt Management Best Practices.	2005	RW Foreman
	• Ensure staff is knowledgeable on the Good Housekeeping Practices.	Ongoing	RW Supervisor
	• Conduct periodic audits of the yard to ensure Good Housekeeping Practices are followed.	Ongoing	RW Foreman
IMPLEMENTATION CONSIDERATIONS	• Without a guideline to follow, past practices may not meet expectations.		
PERFORMANCE MEASURE	• Good Housekeeping Guidelines reviewed or updated. • Yard inspection report on compliance with the Good Housekeeping Guidelines.		
REFERENCE	TAC's Syntheses of Best Practices Road Salt Management - Design and Operation of Road Maintenance Yards		

Storm Response

Weather Forecasting

WEATHER FORECASTING			
OBJECTIVE	To provide timely and accurate weather information to assist in snow and ice control decision-making.		
ENVIRONMENTAL CONSIDERATION	Effective use of chemicals is dependant upon good snow and ice control decision-making, which in turn depends on consistently accurate and timely weather information. Chemicals can be wasted if information is incorrect or suspect.		
CURRENT SITUATION	• The City relies on public weather forecasts provided by Environment Canada and private weather reports from Northwest Weather Net. • Information from two RWIS sites, 6 frost probe locations and 5 IRT's is available to staff. • Weather training has not been provided to staff.		

BEST PRACTICE	• Dedicated weather forecasts are provided frequently enough during the day that decision-makers can make accurate snow and ice control decisions. Forecasts include:
	  • Air temperature forecast
	  • Type and duration of precipitation
	  • Start and end times for precipitation
	  • Dew point
	  • Wind speed and direction
	  • Cloud cover
	• Local RADAR is monitored.
	• Staff communicates with other snowfighters to track storms.
	• Pavement forecasts are available from RWIS sites.
	• Staff is knowledgeable in interpreting and using weather and pavement forecast information.		

ACTION PLAN	• Make arrangements to obtain appropriate weather forecasts before the start of each season.	Ongoing	RW Supervisor
	• Ensure staff is knowledgeable in the use of weather information.	2006	RW Supervisor
	• Investigate the use of technology to improve delivery of weather information to the decision makers.	2005	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Proactive chemical use is dependent on anticipating a "saltable event". • Inaccuracies are inherent in weather forecasting and a QC/QA standard is appropriate.		
PERFORMANCE MEASURE	• Percentage of decision-making staff knowledgeable in interpreting weather forecasts. • Delivery of clearly formatted weather forecasts to those that need them. • Accuracy of forecast to experienced weather.		
REFERENCE			

Decision-Making Support Technology

ROAD WEATHER INFORMATION SYSTEMS (RWIS)			
OBJECTIVE	To provide pavement forecast and real-time information from a network of sensors to assist with snow and ice control decisions.		
ENVIRONMENTAL CONSIDERATION	Snow and ice control decisions that are based on road temperature information, as well as air temperature information and precipitation information are more accurate and result in better salt use.		
CURRENT SITUATION	• City staff access information from 2 RWIS sites and 6 frost probe locations. • Training in the interpretation and use of RWIS information has been provided to staff.		
BEST PRACTICE	• RWIS stations are located strategically around the City to facilitate snow and ice control decisions. • RWIS forecasts and information is available to staff making snow and ice control decisions. • Staff is trained in the proper use of RWIS forecasts and information.		
ACTION PLAN	• Provide RWIS forecasts and information to staff.	Ongoing	RW Foreman
	• Evaluate the merits of installing additional RWIS or FAST sites in the City of Kelowna area.	Ongoing	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Mobile infrared thermometers validate real-time pavement temperature trends and help track the forecast. • Learning curve and acceptance timeframe justify a phased implementation strategy for RWIS. • Archiving of RWIS data helps in showing due diligence.		
PERFORMANCE MEASURE	• Number of RWIS sites accessed. • Percentage of decision-making staff knowledgeable in interpreting RWIS data and forecasts. • Delivery of clearly formatted pavement forecasts to those that need them. • Accuracy of forecast-to-experienced conditions. • Percentage downtime of RWIS sites.		
REFERENCE			

INFRARED THERMOMETERS (IRT's)			
OBJECTIVE	To provide real-time pavement temperature trends from truck mounted pavement temperature sensors to assist with snow and ice control decisions.		
ENVIRONMENTAL CONSIDERATION	Snow and ice control decisions that are based on road temperature information, result in better salt use. Real-time information on pavement temperature trends produce more timely decisions on when to deploy and not deploy chemicals.		
CURRENT SITUATION	• The City has 5 truck mounted IRT's. • The accuracy of the IRT's has not been verified. • Staff has not been trained in the use of IRT's.		
BEST PRACTICE	• Truck mounted IRT's are used to monitor pavement temperatures and staff uses pavement temperature information to make snow and ice control decisions. • IRT's are checked and calibrated periodically. • Staff is trained in the proper mounting and use of IRT's.		
ACTION PLAN	• All Foreman vehicles shall be outfitted with IRT's.	2006	RW Supervisor
	• Every pre-wetting and anti-icing capable vehicle shall have an IRT.	2008	RW Supervisor
	• Ensure staff is knowledgeable in the use of IRT's.	2006	R&E Superintendent
	• Verify the accuracy of every IRT annually.	Ongoing	RW Foreman
IMPLEMENTATION CONSIDERATIONS	• IRT's are to track trends and not absolute temperatures. • Cheaper IRT's have higher failure rates and lower accuracy than more expensive units. • IRT's must be properly mounted to prevent erroneous readings.		
PERFORMANCE MEASURE	• Percentage of Foreman vehicles with IRT's. • Percentage of staff knowledgeable in the proper use of IRT's.		
REFERENCE			

Storm Response Approaches

STORM RESPONSE APPROACHES			
OBJECTIVE	To understand and document storm response approaches for different storm scenarios and improve upon practices.		
ENVIRONMENTAL CONSIDERATION	Snow and ice control decisions that vary across the organization may lead to inefficiencies in some response and ultimately results in loss effectiveness of salt use.		
CURRENT SITUATION	• The City has various documented procedures for dealing with various storm conditions. • The Roads and Equipment Superintendent or his designate makes the decision for the need for a response to conditions.		
BEST PRACTICE	• A Storm Response Guide is available to help decision-makers determine how to approach typical and atypical storm scenarios. • Staff is trained in the use of the Guide.		
ACTION PLAN	• Develop the current procedures for dealing with storm events into an Expert Guide to Snow and Ice Control that uses typical and atypical storm responses.	2006	RW Supervisor
	• As new technologies are introduced, review and update the Expert Guide.	Ongoing	RW Supervisor
IMPLEMENTATION CONSIDERATIONS	• Local field experience is valuable and should be incorporated into the training process as much as possible.		
PERFORMANCE MEASURE	• Development and updating of an Expert Guide to Snow and Ice Control.		
REFERENCE	FHWA, AASHTO, TAC, OGRA		

Winter Road Patrol

WINTER ROAD PATROL			
OBJECTIVE	To impact winter road conditions, mobilize appropriate snow and ice control operations, and monitor the storm response.		
ENVIRONMENTAL CONSIDERATION	Accurate monitoring of winter maintenance activities will support appropriate and effective snow and ice control decisions, leading to efficient use of salt.		
CURRENT SITUATION	• Patrolling is handled by City forces. • The roads are patrolled on a regular basis. • Patrolling guidelines exists however they are not included in the Training Manual. • Patrol diaries are kept.		
BEST PRACTICE	• Roads are patrolled regularly during the snow and ice control season. • A patrolling guideline exists. • Logs are maintained of patrolling activities and observations.		
ACTION PLAN	• Continue with the current Winter Road Patrol program.	Ongoing	RW Supervisor
IMPLEMENTATION CONSIDERATIONS	• Cycle frequency relates the level of observations to the required resources. This can govern efficient salt decisions. • Patroller training and experience are key success factors.		
PERFORMANCE MEASURE	• Documentation of road patrolled during winter conditions.		
REFERENCE			

Drift Control

DRIFT CONTROL	
OBJECTIVE	To reduce snow accumulation on roadways and problems associated with drifting and blowing snow.
ENVIRONMENTAL CONSIDERATION	A significant amount of winter maintenance activity is devoted to controlling drifting snow. If a roadway has a lower potential for snow and ice accumulation, then the winter maintenance demands will be correspondingly lower and the need for chemical application will be reduced.
CURRENT SITUATION	• The City does not have a problem with drifting snow and does not take any preventative measures.
BEST PRACTICE	• Areas that are susceptible to drifting problems are known. • Drifting is controlled to limit the amount of drifted snow that needs to be plowed and treated with salt.
ACTION PLAN	• *No action required.*
IMPLEMENTATION CONSIDERATIONS	• There is a cost associated with installing, or arranging for, and maintaining natural or structural snow fencing. • It may take a few winter seasons to determine the optimum snow fence for a given stretch of problem road. • There may be a liability issue due to seasonally installed snow fence debris being left in fields.
PERFORMANCE MEASURE	
REFERENCE	TAC Salt Management Guide

Snow and Ice Control Training

TRAINING			
OBJECTIVE	To ensure that all in-house and sub-contracted staff, including management, supervisors, patrollers and operators, are trained in salt management practices.		
ENVIRONMENTAL CONSIDERATION	To achieve effective implementation of a salt management program, those people charged with delivering the snow and ice control program must understand the rationale behind the measures being implemented as well as what is expected of them. This can only come through a thorough education / training program, including annual refreshers.		
CURRENT SITUATION	• The City has an annual fall meeting with staff and contractos to cover health & safety issues, route revisions, sanding, plowing and liquid operations and procedures and the LOS. • Both in-house and third party material is used. • Staff attend winter maintenance conference and forums including PNS conferences.		
BEST PRACTICE	• An annual training program is given to all winter maintenance staff. • The training program addresses the learning goals set out in TAC's Syntheses of Best Practices Road Salt Management – Training.		
ACTION PLAN	• Review the training program to ensure it addresses the appropriate subject areas set out in TAC's Syntheses of Best Practices Road Salt Management – Training.	Annually	R&E Superintendent
	• Present the training in the fall of each year to all operators, contractors and supervisors.	Annually	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Trainers must be experienced in adult training principles and be able to adjust their instructional techniques to reach a variety of learners.		
PERFORMANCE MEASURE	• Percentage of managers/foreman receiving training each year. • Percentage of operators receiving training each year. • Total annual attendance at training sessions.		
REFERENCE	• OGRA Training materials • TAC's Syntheses of Best Practices Road Salt Management - Training		

Snow Removal and Disposal

Snow Removal and Disposal Guideline

SNOW REMOVAL AND DISPOSAL GUIDELINE			
OBJECTIVE	To ensure snow removal and disposal operations are done efficiently and in an environmentally responsible manner.		
ENVIRONMENTAL CONSIDERATION	A review of disposal operations can lead to adopting methods that are least harmful to the environment. Environmental issues associated with snow disposal sites include: meltwater quality, litter, dust, aesthetics, and noise.		
CURRENT SITUATION	• The City loads, hauls and disposes in the range of 100-300 truck loads of snow each season. • The City has five snow storage and disposal sites available however only one was used during the 2004/2005 season. • The sites have not been engineered or improved in any way. Litter is picked up and the sites are cleaned each spring. • Drainage is primarily overland with much of the meltwater infiltrating into the ground. • The City has Snow Removal & Disposal Guidelines and Guidelines for maintaining the snow storage and disposal sites.		
BEST PRACTICE	• Snow disposal sites are designed and managed in accordance with TAC's Syntheses of Best Practices Road Salt Management - Snow Storage and Disposal. • Snow Removal and Disposal Guidelines exist and are followed.		
ACTION PLAN	• Review the City's future snow removal, storage and disposal needs including assessment of the five existing snow disposal sites.	2006	RW Supervisor
	• Review the City's guidelines for snow removal, storage and disposal.	Ongoing	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• It may be preferred to design an ultimate Snow Removal Program, and have this as background to a staged implementation plan.		
PERFORMANCE MEASURE	• Completion of snow disposal site assessments. • Review and updating of the Snow Removal, Storage and Disposal Guidelines.		
REFERENCE	TAC's Syntheses of Best Practices Road Salt Management - Snow Storage and Disposal.		

Snow Disposal Site Selection Criteria

SNOW DISPOSAL SITE SELECTION CRITERIA			
OBJECTIVE	To ensure that new snow disposal sites are located so as to minimize the adverse effects to the environment.		
ENVIRONMENTAL CONSIDERATION	Snow disposal sites can impact the environment in many ways. Therefore, proper site selection can minimize these impacts. Criteria should include soil permeability, distance from major water course, vegetation characteristics, ecologically sensitive sites, critical wildlife habitat, operational needs (e.g. haul distances) etc.		
CURRENT SITUATION	• The City has five snow disposal sites. • The capacity appears more then sufficient for current snow disposal needs.		
BEST PRACTICE	• Snow disposal sites are designed and managed in accordance with TAC's Syntheses of Best Practices Road Salt Management - Snow Storage and Disposal. • Appropriate agencies are consulted for guidance and approvals.		
ACTION PLAN	• Use TAC's Syntheses of Best Practices Road Salt Management - Snow Storage and Disposal as a guide to developing any new snow storage and disposal sites.	Future	RW Supervisor
	• Consult the appropriate agencies for necessary approvals.	Ongoing	RW Supervisor
IMPLEMENTATION CONSIDERATIONS	• Haul distances are an important consideration in selecting snow disposal sites. • Chlorides are difficult to contain. Therefore melt water management is predominantly to manage other pollutants.		
PERFORMANCE MEASURE	• Percentage of sites meeting TAC's Syntheses of Best Practices Road Salt Management - Snow Storage and Disposal.		
REFERENCE	TAC's Syntheses of Best Practices Road Salt Management - Snow Storage and Disposal.		

Snow Disposal Site Monitoring and Maintenance

SNOW DISPOSAL SITE MONITORING AND MAINTENANCE			
OBJECTIVE	To ensure that snow disposal sites are monitored and maintained so as to minimize the adverse environmental effects of their operations.		
ENVIRONMENTAL CONSIDERATION	Snow disposal sites can impact the environment in many ways. Mitigation measures are implemented as part of site design and standard operating procedures. However, the mitigating measures need to be monitored and serviced to ensure that they continue to be effective. Improperly managed melt water can introduce contaminants into a watercourse in contravention of the Fisheries Act and Ontario Water Resources Act.		
CURRENT SITUATION	• The City picks up litter and cleans the snow storage and disposal sites each spring. • The City does random sampling of runoff including storm sewers and snow disposal sites. • The City does not monitor for the impact of chlorides on the environment.		
BEST PRACTICE	• Snow disposal sites are managed and monitored in accordance with TAC's Syntheses of Best Practices Road Salt Management - Snow Storage and Disposal. • Appropriate agencies are consulted for guidance and approvals.		
ACTION PLAN	• To maintain and monitor the snow disposal site following TAC's Syntheses of Best Practices Road Salt Management - Snow Storage and Disposal.	Ongoing	RW Foreman
IMPLEMENTATION CONSIDERATIONS	• Chlorides are difficult to contain. Therefore meltwater management is predominantly to manage other pollutants.		
PERFORMANCE MEASURE	• *Monitoring criteria will be developed as part of the Guidelines and Policy review and site improvements*		
REFERENCE	TAC's Syntheses of Best Practices Road Salt Management - Snow Storage and Disposal.		

Technology Transfer Review

TECHNOLOGY TRANSFER REVIEW			
OBJECTIVE	To monitor existing available and new approaches and technologies on a continual basis and to recommend pilot studies on the preferred technologies and winter maintenance methodologies.		
ENVIRONMENTAL CONSIDERATION	New techniques, procedures, and technologies may provide new methods of reducing salt entering the environment.		
CURRENT SITUATION	• Staff regularly attends technology transfer conferences. • Staff attends the PNS snow and ice conference.		
BEST PRACTICE	• Winter maintenance personnel are aware of, and report on, current and emerging best practices through attendance at conferences and courses and participation in relevant provincial and national committees.		
ACTION PLAN	• To ensure the latest technologies are studied, reviewed, tested and adopted as appropriate.	Ongoing	R&E Superintendent
	• To participate in conferences and forums geared to the development of salt best management practices.	Ongoing	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Often, individual technologies will not provide the degree of improvement as compared to the synergies of a broader systems approach. • The results of trials should be documented with proper assessment methodologies. • New technologies should first be introduced and proven in one area of the municipality and then expanded to the rest of the municipality.		
PERFORMANCE MEASURE	• Reports on new technologies and practices prepared for Council and the public.		
REFERENCE			

Communications

COMMUNICATIONS			
OBJECTIVE	To communicate effectively with the public and the media about the importance of road salt to maintaining safe roadways during the winter season and about what the City of Kelowna is doing to improve salt management. To inform the public about the current level of service policy.		
ENVIRONMENTAL CONSIDERATION	An informed public and media are more likely to become effective partners in achieving the goals of the Salt Management Plan.		
CURRENT SITUATION	• The City has a program to inform the public, staff and Council of service expectations or significant changes to winter maintenance operations. • The Public needs to be made more aware of the hazards during winter driving, slow down and drive according to conditions.		
BEST PRACTICE	• A communication program exists to inform staff, politicians and the public of the City's salt management initiatives. • An annual report on progress on the SMP is sent to Environment Canada. • Road authorities with overlapping jurisdictions communicate regularly with each other to identify common problems and share solutions.		
ACTION PLAN	• Inform the Council, public and local regulatory agencies about the actions being taken by the City to manage road salt use, and the City's winter maintenance program annually.	Ongoing	R&E Superintendent
	• Notify Environment Canada upon completion of the Salt Management Plan and update them annually about the status of Salt Management activities (as per Annex C of the Code of Practice for the Environmental Management of Road Salts).	Ongoing	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Repetition may be necessary to ensure the message is heard. Safety-first must continually be reinforced.		
PERFORMANCE MEASURE	• Communication Plan reviewed or updated. • Appropriate stakeholders are informed of the City's Road Salt Management initiatives.		
REFERENCE			

Salt Vulnerable Areas

SALT VULNERABLE AREAS	
OBJECTIVE	To determine if any salt vulnerable areas are potentially impacted by the use of salt.

ENVIRONMENTAL CONSIDERATION	"Salt vulnerable area" means an area particularly sensitive to road salts where additional salt management measures may be necessary to mitigate the environmental effects of road salts in that area; vulnerable areas should be identified as per the guidance provided in Annex B of the Code. Salt vulnerable areas may require unique solutions that may require the use of alternative strategies/methods or more expensive non-chloride snow and ice control materials to maintain roads through the sensitive areas.		
CURRENT SITUATION	• There are currently discussions ongoing at the national level on salt vulnerable areas. • The City has many unique environmental features including the Mountains, rivers and environmentally significant areas. • There has not been an effort to formally correlate the features to roadways or salt storage sites.		
BEST PRACTICE	• Salt Vulnerable Areas are identified and factored into salt management decision-making.		
ACTION PLAN	• Work with other agencies to identify and map salt vulnerable areas in the City.	2007	R&E Superintendent
	• Identify strategies to reduce salt impacts to salt vulnerable areas.	2008	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• There is no clear consensus on how to monitor the impacts to vulnerable areas. • Other agencies should help identify salt vulnerable areas.		
PERFORMANCE MEASURE	• Number of salt vulnerable areas identified. • Number of winter maintenance prescriptions developed in response to salt vulnerable areas. • Relative change in impact indicators.		
REFERENCE			

Record Keeping

MATERIAL USAGE RECORD KEEPING			
OBJECTIVE	To provide an accurate record of how much material was used, where it was used and the reason it was used.		
ENVIRONMENTAL CONSIDERATION	Effective salt management requires an accurate understanding of how much salt is being used, and where. It is not sufficient to measure gross totals since these can very widely from year-to-year due to weather fluctuations.		
CURRENT SITUATION	• The delivery and restocking of solid bulk material is manually tracked by the Foreman. • Blended sand usage is tracked manually by the bucket load by each operator. • Blended sand usage is recorded on the TRM card. • Blended sand usage is not reconciled with deliveries at the end of the season.		
BEST PRACTICE	• Data is collected electronically from electronic controllers and used to assess salt management practices. • Delivery and use of materials is tracked and reconciled at year-end. • Material usage is tracked in conjunction with Storm Response Records.		
ACTION PLAN	• Data from the electronic controllers will continue to be regularly retrieved, reviewed and archived.	Ongoing	RW Foreman
	• Data from the electronic controllers and the TRM forms will be compared and used to reconcile with deliveries.	Annually	RW Foreman
	• Information from the operator and patroller/foreman logs along with RWIS, forecast and future system information will be retrieved, reviewed and archived along with the material usage data.	Ongoing	RW Foreman
	• Salt, sand and liquid delivery records and end-of-season residual will be logged to allow for year-end reconciliation of bulk material use.	Ongoing	RW Foreman
	• Periodic comparisons of usage by route will be carried out to identify and address any inconsistencies.	Ongoing	RW Foreman
	• Ensure staff is knowledgeable in the Material Usage Tracking System and record-keeping.	Ongoing	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Material use is dependent upon the severity of the winter and therefore record analysis needs to normalize for the type of winter. • Material usage records in conjunction with the overall winter maintenance program can serve as a surrogate for a winter severity index. • High sand usage has cleanup and dust implications.		

PERFORMANCE MEASURE	• Tonnes of salt applied through spreading operations. • Tonnes of salt used per lane km. • Tonnes of sand used. • Litres of liquids used. • Material reconciliation and summary at the end of the season. (amount at start of season + purchases/production - actual usage = amount at end of season) • Daily records checked for completeness.
REFERENCE	

STORM RESPONSE RECORD KEEPING			
OBJECTIVE	To provide accurate documentation of changing road and weather conditions, and actions taken during storm response.		
ENVIRONMENTAL CONSIDERATION	Accurate record keeping and reporting during snow and ice control activities will facilitate a review of storm response and ultimately result in the most effective response in similar situations. This can help to optimize the use of salt. It will also provide information for due diligence defence in the event of a lawsuit by demonstrating prudent judgement with regard to safety and environmental stewardship.		
CURRENT SITUATION	• Storm event response records and patrol logs are reviewed and kept. • RWIS and the electronic controllers provide an opportunity to have a partial electronic record of conditions and response times.		
BEST PRACTICE	• Accurate records of decisions made in responding to a storm are kept and can be retrieved for analysis.		
ACTION PLAN	• Review the Record Keeping Policy and records kept. Ensure it includes a standard methodology to report/summarize storm response.	Ongoing	RW Supervisor
	• Information from the forecasts, logs, RWIS and future systems will be retrieved, reviewed and archived along with the material usage records.	Ongoing	RW Foreman
	• Ensure staff is knowledgeable in the Record Keeping Policy.	Ongoing	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Record keeping can be observation and action-oriented. • It can document what was known and the rationale for decisions including what was not done (by choice). • Storm responses are recorded and maintained in conjunction with material usage records.		
PERFORMANCE MEASURE	• Record Keeping Policy reviewed or updated. • Percentage of operations staff knowledgeable in proper record keeping. • Accurate and complete record of storm response. • Percentage of representative samples of records in conformance with the policy.		
REFERENCE			

Monitoring Program

MONITORING PROGRAM			
OBJECTIVE	To monitor the chloride concentrations along rivers, snow disposal sites, salt storage facilities, and selected environmentally sensitive areas to determine the effectiveness of salting reduction strategies.		
ENVIRONMENTAL CONSIDERATION	By monitoring the effectiveness of the Salt Management Plan mitigation strategies, this may demonstrate improvements to the amount of salt entering the environment.		
CURRENT SITUATION	• The City currently has no formal program to monitor chloride levels in the environment and relate those levels to winter maintenance activities. • The City has not carried out a contaminant assessment at its yard.		
BEST PRACTICE	• Data on chloride concentrations are collected and analyzed to assess the nature and trends in salt contamination. Monitoring is conducted at salt and sand storage areas, snow disposal sites, in the surrounding, potentially impacted environment and at salt vulnerable areas.		
ACTION PLAN	• Monitor developments on the National level with respect to monitoring requirements for salt management plans.	Ongoing	R&E Superintendent
	• Develop a monitoring program, in cooperation with the City's Environment Department, to monitor the impact of salt on the environment. Ensure it is integrated with the snow storage and disposal site program.	2007	R&E Superintendent (in cooperation with) Environment Dept.
	• Conduct an assessment of the City's Winter Maintenance yard.	2006	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Other parameters may affect interpretation of the data, such as traffic volumes, winter index, climate variations, etc.		
PERFORMANCE MEASURE	• *To be determined in conjunction with developments at the national level.* • Percentage of yards properly assessed.		
REFERENCE			

Emergency Response Program

EMERGENCY RESPONSE PROGRAM			
OBJECTIVE	To be prepared to respond to emergencies or hazardous situations involving winter maintenance operations and contain and clean-up the situation as required without compromising the Health & Safety of workers		
ENVIRONMENTAL CONSIDERATION	Environment Canada has done an assessment of road salt and has concluded that the excessive use of road salts can be harmful to the environment. A spill or release involving snow and ice control chemicals may involve the release of a significant amount of salt into the environment.		
CURRENT SITUATION	• The City currently has an Emergency Response Plan for roadway spills. • The City does not have a formal plan to respond to a spill or release of solid salt or liquid snow and ice control chemical on road and at its maintenance yard.		
BEST PRACTICE	• A response plan for dealing with spills of snow and ice control chemicals exists. • Personnel are trained in how to respond to a spill.		
ACTION PLAN	• Develop a Response Plan Policy for salt spills.	2006	R&E Superintendent
	• Ensure staff is knowledgeable in the potential hazards and the Response Plan.	Ongoing	R&E Superintendent
IMPLEMENTATION CONSIDERATIONS	• Communication and coordination with other agencies responsible for Emergency Response will be required.		
PERFORMANCE MEASURE	• Development of a Response Plan Policy. • Percentage of staff knowledgeable in the Response Plan.		
REFERENCE			

MONITORING AND UPDATING THE SALT MANAGEMENT PLAN

MONITORING

Overview

This chapter of the plan includes table summaries of current practices to allow tracking of the Salt Management Plan Reviews and the implementation of the Plan.

Salt Management Plan Review

An annual management review will take place as part of the plan. During this review the Salt Management Plan will be updated to include changes in departmental policy, as well as to summarize new strategies and techniques deployed. It will also allow the City to measure and report upon progress towards established goals and standards outlined in the previous chapter dealing with operational practices and strategies.

Salt Management Plan Review					
Progress	**Year**				
	2006	**2007**	**2008**	**2009**	**2010**
Salt Management Plan reviewed.					
Salt Management Plan updated.					
Salt Management information sent (*according to Environment Canada's Code of Practice for the Environmental Management of Road Salts).*					

The following areas will be included in the annual analysis and review:

- Management Practices
  - Level of service
- Equipment
  - Fleet Allocation/Optimization
  - Fleet Upgrading
  - Equipment Maintenance and Calibration
  - Equipment Washing
- Materials
  - Material Ordering and Delivery
  - Material Application Rates
  - Sand/Salt Blends
  - Material Storage / Handling
  - Good Housekeeping Practices for Maintenance Yards
- Storm Response Summary
  - Weather Forecasting
  - Decision-Making Support Technology
  - Storm Response Approaches
  - Winter Road Patrol
  - Drift Control
- Snow and Ice Control Training
- Snow Removal and Disposal
  - Snow Removal and Disposal Guideline
  - Snow Disposal Site Selection Criteria
  - Snow Disposal Site Monitoring and Maintenance
- Technology Transfer Review
- Communications
- Salt Vulnerable Areas
- Record Keeping
- Monitoring Program
- Emergency Response Program

The following summaries can contribute to future management reviews of the implementation of the Salt Management Plan.

Management Practices

Level of Service

Level of Service Policy					
Progress	**Year**				
	2006	**2007**	**2008**	**2009**	**2010**
An LOS policy that has been endorsed by senior management and adopted by Council.					
Compliance with the LOS policy throughout the organization.					

Equipment

Fleet Allocation/Optimization

Fleet Allocation/Optimization					
Progress	**Year**				
	2006	**2007**	**2008**	**2009**	**2010**
Route reviews completed.					
Achieved the stipulated LOS for each class of road.					

Fleet Upgrading

Electronic Spreader Controls					
Progress	**Year**				
	2006	**2007**	**2008**	**2009**	**2010**
Percentage of material application units with electronic controllers.					
Percentage of salt placed by spreaders with electronic controllers.					
Percentage of brine placed by spreaders with electronic controllers.					

Pre-wetting and Anti-Icing Equipment					
Progress	**Year**				
	2006	**2007**	**2008**	**2009**	**2010**
Percentage of spreaders with pre-wetting capabilities.					
Number of units capable of anti-icing.					
Percentage of staff knowledgeable liquid use and handling.					

Equipment Maintenance and Calibration

Spreader Calibration					
Progress	**Year**				
	2006	**2007**	**2008**	**2009**	**2010**
Percentage of units calibrated prior to each season.					
Number of in-season re-calibrations.					

Equipment Washing

Equipment Washing					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Washwater management guideline developed or updated.					
Percentage of sites with washwater management facilities consistent with guideline.					

Materials

Material Ordering, and Delivery

Material Ordering and Delivery

Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Summary of quality tests for materials received.					
Percentage of deliveries that did not meet specifications.					

Material Application Rates

Material Application Rates					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Material application rates reviewed or updated.					
Tonnes of salt applied through spreading operations.					
Litres of brine applied through spreading operations.					

Sand/Salt Blends

Sand/Salt Blends					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Percentage of salt in sand/salt blends.					
Tonnes of sand used.					

Material Storage / Handling

Salt Storage / Handling	
~~Progress~~	Year

	2006	2007	2008	2009	2010
Number of new storages designed in accordance with TAC's Syntheses of Best Practices.					
Percentage of salt used that was stored in covered storage facilities.					
Percentage of salt storage facilities that have drainage water management systems.					

Blended Sand Storage / Handling					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Percentage of sand/salt blends stored indoors in impermeable pads.					
Number of new storages designed in accordance with TAC's Syntheses of Best Practices.					
Percentage of blended sand/salt storages with drainage water management systems.					

Liquid Storage / Handling					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Percentage of liquids used that were stored in tanks with spill containment.					
Number of new liquid storage facilities designed in accordance with TAC's Syntheses of Best Practices.					

Good Housekeeping Practices for Maintenance Yards

Good Housekeeping Practices	
~~**Progress**~~	**Year**

	2006	2007	2008	2009	2010
A Good Housekeeping Guideline reviewed or updated.					
Number of sites audited for compliance.					

Storm Response

Weather Forecasting

Weather Forecasting					
Progress	Year				
	2006	2007	2008	2009	2010
Percentage of decision-making staff knowledgeable in using weather forecasts.					
Weather forecast delivered in a timely manner.					
Accuracy of weather forecasts.					

Decision-Making Support Technology

Road Weather Information Systems (RWIS)					
Progress	Year				
	2006	2007	2008	2009	2010
Number of RWIS sites accessed.					

Percentage of decision-making staff knowledgeable in RWIS.					
RWIS forecasts delivered in a timely manner.					
Accuracy of RWIS forecasts.					
Percentage downtime of RWIS sites.					

Infrared Thermometers (IRT's)					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Percentage of Foreman vehicles with IRT's.					
Percentage of staff knowledgeable in the use of IRT's.					

Storm Response Approaches

Storm Response Approaches					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Storm Response Guide prepared or updated.					

Winter Road Patrol

Winter Road Patrol					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Documented road patrolling during winter conditions.					

Drift Control

Drift Control					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
No applicable performance measure.					

Snow and Ice Control Training

Training					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Percentage of managers and foreman trained.					
Percentage of operators trained.					
Number in attendance at training sessions.					

Snow Removal and Disposal

Snow Removal and Disposal Guideline

Snow Removal and Disposal Guideline					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Percentage of snow disposal sites assessed.					

Snow Removal and Disposal Guidelines developed or updated.					

Snow Disposal Site Selection Criteria

Snow Disposal Site Selection Criteria					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Percentage of new snow disposal sites meeting TAC's Syntheses of Best Practices.					

Snow Disposal Site Monitoring and Maintenance

Snow Disposal Site Monitoring and Maintenance					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
To be developed as part of the Guidelines and Policy development.					

Technology Transfer Review

Technology Transfer Review					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Report on new technologies and practices prepared.					

Communications

Communications					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Communication Plan reviewed or updated.					

Appropriate stakeholders informed.					

Salt Vulnerable Areas

Salt Vulnerable Areas					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Number of salt vulnerable areas identified.					
Number of winter maintenance prescription developed in response to salt vulnerable areas.					
Relative change in impact indicators.					

Record Keeping

Material Usage Record Keeping					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Tonnes of salt applied through spreading operations.					
Tonnes of salt used per lane km.					

Tonnes of sand used.					
Litres of liquid used.					
End of season material reconciliation completed.					
Percentage of daily records completed accurately.					

Storm Response Record Keeping					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Record Keeping policy reviewed or updated.					
Percentage of staff knowledgeable in proper record keeping.					
Accurate and complete record of storm responses.					
Percentage of records in compliance with policy.					

Monitoring Program

Monitoring Program					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
To be determined in conjunction with developments at the national level.					
Percentage of yards properly assessed.					

Emergency Response Program

Emergency Response Program					
Progress	Year				
	2006	**2007**	**2008**	**2009**	**2010**
Maintenance Yard Response Plan Policy developed or updated.					
Percentage of staff knowledgeable in the Response Plan.					

Appendix A

Snow and Ice Control Training Manual
(Revision List)

Manual - Revision List

Document	Revision Date
Snow and Ice Control Training Manual	October 29, 2004

Appendix B

Application Rate Tables
Weather Event Action Forms

The following tables are a summary of the City of Kelowna's snow and ice control material application rates as they are used operationally and the Weather Event Action Forms.

TABLE B.1 – APPLICATION RATES – SALT[4] (kg / 2 lane km)

Storm Category	Description	Average Snowfall Rates	Pre-wetted salt rate (kg/2 lane km)	Average Snowfall Accumulation (cm)	Road Surface Temp.
1	**Light with freezing rain,** rain with light snow mix.	Less than 2.5 cm in 4 hours.	56	0 cm	Near -1°C
2	**A weak storm**, with light snowfall rates and minimal accumulation. Travel is only impaired slightly.	Less than 2.5cm in 4 hours.	140	2.5 cm	Near -1°C
3	**A marginal storm**, but a burst of heavier snow sometimes occurs, reducing visibility temporarily. Final accumulation is greater than with a Cat. 1. Travel is impaired more significantly, especially during the heavier snow bursts, but still not difficult.	Less than 2.5 cm in 2 hours, with a brief period of 2.5 cm/hour snowfall.	85 - 225	9 cm	Below -1°C and falling
4	**A significant storm**, with moderate snowfall rates occurring through about half the storms duration. Travel at the onset of the storm is impacted and becomes difficult by the end of the storm.	2.5 cm/hour or greater.	0	10 cm plus	Below -6°C and falling

TABLE B.2 – APPLICATION RATES – ABRASIVES[4] (kg / 2 lane km)

Condition	Light with freezing rain	Light with snow	Normal Below -12°C	Heavy Below -12°C
Dry Abrasive				
Pre-wetted Abrasive			422	562

TABLE B.3 – APPLICATION RATES – LIQUIDS[4]

NOTE:
1) These quantities are based on 1mm of precipitation per 1 cm. (10 mm) of snow

[4/] The application rates and actions identified in the tables have been set by the City. Ecoplans Limited does not warrant that these rates and actions will provide safe driving conditions.

2) To be used only as a guideline

Rates for snow falls in excess of 5 cm.

Surface Temp. (c)	Forecasted Precipitation			
	5 cm.	7.6 cm.	10 cm.	12.7 cm.
-1.1	90 Lt.	105 Lt.	120 Lt.	135 Lt.
-2.2	105 Lt.	120 Lt.	135 Lt.	135 Lt.
-3.9	120 Lt.	135 Lt.	135 Lt.	150 Lt.
-6.7	135 Lt.	135 Lt.	150 Lt.	165 Lt.
-7.8	135 Lt.	150 Lt.	165 Lt.	185 Lt.
-8.8	150 Lt.	165 Lt.	185 Lt.	200 Lt.
-10	165 Lt.	185 Lt.	200 Lt.	215 Lt.
	Liters per Lane Kilometer			

Anti-icing rates for Black Ice and Light/Moderate snow falls from 30 - 90 Liters per Lane Kilometer.

High volumes of material should be applied in 2 or more applications.

Never exceed 120 liters per lane kilometer without discussing with your Foreman.

WEATHER EVENT ACTION FORMS[4]

BLACK ICE OR FROST

Definition: Popular term for a very thin coating of clear homogenous ice which form on pavement with a temperature at or slightly above 0^0 when the temperature of the air in contact with the ground is below the freezing-point of water and small supercooled water droplets deposit on the surface and flow together before freezing.

Pavement Temperature Range and Trend	**INITIAL OPERATIONS**			**SUBSEQUENT OPERATIONS**		**Comments**
	pavement surface at time of initial operation	maintenance action	liquid rates Lt/Km.	maintenance action	liquid rates Lt/Km.	
-2^0…..$+2^0$ and remaining in this range		Apply liquid	15 - 30 LT per Ln/Km	Reapply liquid as needed	15 - 30 LT per Ln/Km	1) Monitor pavement closely. If pavement becomes wet or if thin ice forms, reapply. 2) DO NOT USE liquids on ice so thick that pavement can not be seen.
-7^0…..-2^0		Apply liquid	45 - 60 Lt. per Ln/Km	Reapply liquid as needed	45 - 60 Lt. per Ln/Km	1) Same as 1 above. 2) Applications may need to be more frequent at higher levels of condensation.
-10^0…..-7^0 and falling		Apply Liquid	60 -90 Lt. per Ln/km	Reapply liquid **"CAUTIOUSLY"** as needed	60 -90 Lt. per Ln/Km	1) Ensure that surface temperature is maintaining in this range. **2) DO NOT use liquids below -12^0**

LIGHT SNOW STORM

Definition: Snow falling at a rate less than 12 mm (1/2") per hour. Visibility not adversely affected.

Pavement Temperature Range and Trend	**INITIAL OPERATIONS**			**SUBSEQUENT OPERATIONS**		**Comments**
	pavement surface at time of initial operation	maintenance action	liquid rates Lt/Km.	Maintenance action	liquid rates Lt/Km.	
0^0…..-7^0 and remaining in this range	Dry	Apply liquid	75 -90 LT per Ln/Km	Plow off slush or snow before Reapplying.	Adjust application rate according to weather forecast and duration	1) Application will need to be more frequent at lower temperatures and higher snowfall rates. 2) It is not advisable to apply liquid at the indicated rate when surface temperature starts to fall below -5^0. 3) Do not apply liquid to heavy compact.
	Wet, slush or light snow cover	Plow and apply liquid	90-105 Lt. per Ln/Km			
-7^0…..-10^0 and remaining in this range	Dry, wet, slush or light snow cover	Plow and apply liquid	135 -165 Lt. per Ln/Km	Plow as needed and reapply	Adjust application rate according to Weather forecast and duration	1) Be aware of the Dilution of Solution and Surface Temperature **(RE - FREEZE).**
-10^0 and falling	Dry or light snow cover	Plow as needed	N/A	Plow as required	N/A	**1) DO NOT use liquids below -12^0**

HEAVY SNOW

Definition: Snow falling at a rate of 12 mm (1/2") per hour or greater. Visibility not adversely affected.

Pavement Temperature Range and Trend	**INITIAL OPERATIONS**			**SUBSEQUENT OPERATIONS**		**Comments**
	pavement surface at time of initial operation	maintenance action	liquid rates Lt/Km.	maintenance action	liquid rates Lt/Km.	
0^0.....-7^0 and remaining in this range	Dry					
	Wet, slush or light snow cover					
-7^0.....-10^0 and remaining in this range	Dry, wet, slush or light snow cover					
-10^0 and falling	Dry or light snow cover					