



## **SUMMARY**

One of the main challenges facing Canadian cities is the maintenance of their roadway systems to provide safe winter driving conditions. In Edmonton, more than 165,000 tonnes of sand and salt are applied annually to the city's roads. In the past, almost all of these materials were swept up in the spring and disposed of in a landfill. In 2003, the City of Edmonton Transportation and Streets Department and the Edmonton Waste Management Center of Excellence formed a partnership, to investigate the feasibility of recycling street sweepings. The winter street sand recycling pilot project, partially funded by a grant from the Federation of Canadian Municipalities Green Fund, had dramatic results. The pilot project was able to recover and recycle 80% of the collected street sweepings for re-use as winter street sand. Based on this success, the Winter Street Sand Recycling Program was developed. This unique corporate initiative demonstrated the City of Edmonton's on-going commitment to the protection of the environment and the conservation of Alberta's natural resources.

## **THE PROBLEM: CONTAMINATED STREET SAND**

Canadian winters provide challenging driving conditions for motorists. To improve traction under ice and snow pack conditions, salt combined with coarse sand and manufactured chips are commonly used as traction aids. The City of Edmonton has approximately 15,000 lane-kilometers of paved-surface roadways, including approximately 4,500 lane-kilometers of major truck routes. The City places approximately 165,000 tonnes of winter street sand on its roadways annually for winter maintenance operations. Approximately 115,000 tonnes (70%) of these materials are subsequently recovered each spring through street sweeping operations. Historically, only about 25% of the recovered street sand has been reused, generally by blending the recovered sand with new sand material. The majority of the remaining 75% of the recovered street sweepings were landfilled.

It has been found that the street sweepings exceed the electrical conductivity (EC) and sodium absorption ratio (SAR) limits of the Salt Contamination Assessment and Remediation Guidelines (AENV 2001). As such, they must be disposed of in a regulated Class II landfill. In 2002, 115,000 tonnes of street sand sweepings contaminated with salt, hydrocarbons, road litter, leaves, grass and soil were landfilled. This quantity would equal 60% of the total weight of materials landfilled on an annual basis, severely impacting the capacity of the City's landfill site. This disposal option was expensive, reduced the overall capacity of the landfill and accelerated the depletion of natural, non-renewable sand resources. A more cost effective and environmentally sustainable solution had to be found.



**Salt and Winter Street Sand being placed on City of Edmonton streets during the winter**



**Winter Street Sand being picked up off City of Edmonton streets in the spring**

## **PROJECT DESCRIPTION**

### **INITIATION OF A PILOT PROJECT TO RECYCLE STREET SWEEPINGS**

In 2003, the City of Edmonton Transportation and Streets Department and the Edmonton Waste Management Center of Excellence formed a partnership to investigate solutions to the problem of contaminated street sand. After extensive review, a pilot project partially funded by a grant from the Federation of Canadian Municipalities Green Fund, was initiated to determine the feasibility of recycling street sweepings. The winter street sand recycling pilot project was initiated to develop a cost effective and environmentally acceptable alternative to the landfilling of street sweepings.

### **CONCEPTUAL PLANNING PHASE OF THE WINTER STREET SAND RECYCLING PILOT PROJECT**

The planning phase of the program began with a review of the problem. Over the past 20 years, the City of Edmonton had conducted quality assurance gradation and analytical analyses of both natural street sand products and recovered street sweeping materials. This provided a good understanding of the material properties (grain size, particle characteristics etc.) that were important in a street sand product. This review also provided an understanding of the characteristics of the non-desirable inclusions present in street sweepings such as hydrocarbons, road litter, leaves, grass and soil. The gradation data collected on street sweepings from both the arterial and residential road systems indicated that over 80% of the annual street sweepings were potentially recyclable. What was unknown was the kind of process that could be used to recycle these sweepings.



**Stockpile of City of Edmonton street sweepings prior to processing**

## **INVESTIGATION AND IMPLEMENTATION OF THE RECYCLING PROGRAM**

Initially both dry and wet processing alternatives were considered. The dry processing alternative was rejected due to the high capital cost of the equipment, and operational concerns regarding airborne dust. The wet processing concept chosen to be investigated, and ultimately implemented, was a method that combined various technologies developed by the aggregate, concrete and petrochemical industries to process granular materials. The four-phase process that was developed consisted of the following:

### ***Phase 1: Waste Removal***

Initially, the street sweepings are loaded into a hopper feed system that conveys the sand to a vibrating screen deck. This removes litter and gravel larger than 10 mm from the street sand. An estimated 6,900 tonnes (6%) of material is removed from the street sweepings at this point in the process. The gravel is then used in the production of recycled aggregates and the litter materials are further evaluated for potential recycling opportunities before disposal.



**Removal of oversize and litter**

## ***Phase 2: Material Washing***

The remaining material from Phase 1 is conveyed to a fines separator. This vibrating and rotating gravity separation device washes the fines (material smaller than 300 microns) from the street sweepings. The fines containing approximately 30% solids are then redirected for further processing. The remaining clean sand material is separated by gravity and flows through a center discharge point for further dewatering and drying. The water for the washing process comes from either the landfill groundwater collection system reservoir at the Meridian Street location, or from snow meltwater ponds at the snow storage facilities, where processing will occur.



**Ortner fines separator**

## ***Phase 3: Fines Processing***

The smaller than 300 micron material removed by the primary washing at the fines separator, is pumped into a cyclone which removes up to 75% of the water. This water is returned to the pond to settle out the suspended solids. The remaining solids separated by the cyclone are pumped to a dewatering screen, which further dewateres the material prior to stockpiling, where it is allowed to gravity drain and air dry. Water recovered from the dewatering screen is returned to the cyclone and further reprocessed.



**Cyclone & dewatering screens**



**Wash water returned to settling ponds**

#### ***Phase 4: Clean Sand Dewatering and Drying***

The clean street sand resulting from the initial washing leaves Phase 1 of the process in a saturated condition. This wet sand is conveyed from the washing process to a dewatering screen, which reduces the moisture content of the sand to approximately 10%. This sand is then placed in a stockpile and allowed to gravity drain and air dry. The stockpiled material will typically dry to a moisture content of less than 4% in 30 to 60 days. The sand is then shipped to the City of Edmonton's, Transportation and Streets' maintenance yards for re-use on city streets.



**Dewatering screen**



**Stockpile of recycled winter street sand**

### **TANGIBLE ENVIRONMENTAL RESULTS OF THE WINTER STREET SAND RECYCLING PROGRAM**

#### ***Diverting Sand Material Away From the Landfill***

Based on the results of the pilot project, of the roughly 115,000 tonnes of material collected annually from Edmonton's streets, approximately 92,000 tonnes (80%) can be recovered through the Winter Street Sand Recycling Program. Around 2,300 tonnes (2%) will be aggregate-sized material that is too large for street sand. It will be diverted to the City of Edmonton aggregate recycling operation. Approximately 6,900 tonnes (6%) will be washed fine sand that is too small for use as street sand. This material is available for use as a fine aggregate for fillcrete applications. In total, roughly 101,000 tonnes (88%) of material collected from the City's streets will be diverted from the landfill. This diversion of material represents a saving of landfill capacity, which significantly prolongs its life.

Of the roughly 115,000 tonnes of material collected from the City's streets, 14,000 tonnes (12%) cannot presently be recycled. The make up of this material consists of 9,400 tonnes (8%) of material consisting of silt and clay size particles and 4,600 tonnes (4%) of road litter,

both of which must be landfilled. Alternate uses of these fine-grained materials are currently being investigated. Also under evaluation is the potential re-use of the residual salt washed into the settling ponds. This could result in the reduction of new salt required for winter street sand.

### ***Improved Air Quality***

Currently, 700,000 kilometers of truck travel will be eliminated as a result of the Winter Street Sand Recycling Program. In terms of greenhouse gas emissions, this reduction in travel will result in a savings of more than 1,000 tonnes of CO<sub>2</sub>. Larger savings will be realized, as new reserves are required to be developed further from the City. Through the recycling program, the amount of fine-grained material present in the winter street sand will be reduced. This reduction of fine grained material will reduce the amount of PM10 material discharged to the atmosphere through traffic movement and street sweeping activities. The reduction in air particulate matter and CO<sub>2</sub> gas emissions from truck travel represent an enhancement to the environment through improved air quality.

### ***Reducing the Need for New Sand Materials***

The Winter Street Sand Recycling Program will further contribute to the preservation of the environment through the significant reduction in the amount of new sand material required to be mined. Without a recycling option, the City of Edmonton had to obtain new sand materials from existing reserves every year. However, with 80% of the total street sweeping material now being recovered for re-use as winter street sand, this will significantly reduce the rate of depletion of reserves of natural sand deposits, a non-renewable resource. Less reliance on obtaining new natural materials will decrease the need to develop new reserves and reduce the negative impacts on the environment and biodiversity of the areas where they are located.

### ***Reducing Transportation Impacts***

The Winter Street Sand Recycling Program will also result in the winter street sand inventory being strategically located throughout the City, further improving the efficiency of street sanding activities including the use of the material during road maintenance emergencies (i.e. freezing rain). The processing of material will also be carried out at several locations thereby reducing the amount of trucking required for haul of material to the maintenance yards. The reduction in total truck travel will also have a positive effect by reducing infrastructure damage and traffic noise.

## **INTANGIBLE ENVIRONMENTAL BENEFITS OF THE WINTER STREET SAND RECYCLING PROGRAM**

The Winter Street Sand Recycling Program could change the way other municipalities approach the common urban practice of street sanding. The City of Edmonton's Transportation and Streets Department and the Edmonton Waste Management Center of Excellence, have offered to assist other Canadian municipalities in the recycling of their

roadway sanding materials. The process has also been reviewed by The National Research Council. The results of their study will be released in 2005 and the process developed through the Winter Street Sand Recycling Program will be included as part of their Best Practice Guide to Sustainable Municipal Infrastructure.

## **DEMONSTRATION OF EFFORT OR COMMITMENT**

Based on the success of the pilot project, the City of Edmonton and the Edmonton Waste Management Center of Excellence have entered into an agreement to recycle more than 900,000 tonnes of street sweeping in Edmonton over the next 6 years. The agreement also commits to conduct further research and development of the technology. The benefits of the Winter Street Sand Recycling Program are long-term, as demonstrated by the corporate and financial commitment made by The City of Edmonton. It will also fit well with the City of Edmonton's initiatives to develop an Environmental Management System and become an ISO 14001 registered organization.

## **INNOVATION / GOING THE EXTRA MILE**

The Winter Street Sand Recycling Program has proven to be an innovative and unique approach to the handling of contaminated winter street sand. It is believed that this type of recycling initiative has never been undertaken on a production scale in North America, nor anywhere else. As described, virtually every municipality in the snow belt of North America could potentially benefit from this innovative process. The pilot project identified the core equipment components and modifications required for the process. The majority of the components are commercially produced and readily available. Most municipalities, with their existing infrastructure and activities, should be readily able to duplicate the City of Edmonton's success.

## **CONCLUSION**

Through its Winter Street Sand Recycling Program, The City of Edmonton and the Edmonton Waste Management Center of Excellence have developed a technically and economically viable means of reducing the environmental impacts associated with the placement of salt and sand on city streets. This program further demonstrates the City of Edmonton's ongoing commitment to the protection of the environment and the conservation of Alberta's natural resources.

The City of Edmonton, Winter Street Sand Recycling Program system is described by the following flow chart:





