

# ***Dakota County Winter Maintenance Training KAP Study Report***

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*Dakota County snowplows*

*Source: <http://www.co.dakota.mn.us/EnvironmentRoads/RoadSafety/WinterDriving.htm>*

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## **Executive Summary**

De-icing chemicals applied to roadways can impair water quality and habitat, and are costly for local governments to purchase and to apply. Fortin Consulting and the Minnesota Local Technical Assistance Program provided a Minnesota Pollution Control Agency-sponsored winter maintenance training course for snowplow drivers in Dakota County Minnesota in November 2008. The goal was to improve operator effectiveness, and to reduce the amount of chemicals entering nearby water bodies. To evaluate the training, a KAP (knowledge, attitudes and practices) study was administered beforehand to establish a baseline. The study was repeated after two winter maintenance seasons and the results were compared. *Fourteen months post-training, KAP results documented measureable improvements in driver knowledge, attitudes and practices related to specific application activities.* The study confirmed that the winter maintenance training fostered many changes in driver behavior and knowledge. The study also demonstrates the utility of the KAP method to document specific results related to social outcomes for water quality and training projects.

## **Introduction**

The Minnesota Pollution Control Agency (MPCA) and the University of Minnesota's Water Resources Center (WRC) have partnered to test the effectiveness of several social evaluation methods. Efforts to better quantify the beneficial effects of funding programs that address behavior change in non-point source (NPS) water quality improvement projects have been underway for a number of years. The U.S. Environmental Protection Agency (USEPA) provides funding to develop and test evaluation frameworks that can support the underlying premise that social change is measureable and quantifiable. By social change and social outcomes, we mean that a target audience adopts and maintains a recommended "best management practice" (BMP). We are also interested in whether barriers or constraints to adoption are reduced, and whether local participation or civic engagement in a project has increased.

The MPCA has developed a half-day voluntary training and certification program for winter maintenance professionals. The goal of this course is to reduce the environmental impacts of chemicals applied to roads, parking lots and sidewalks, without compromising public safety. This training program was selected to participate in pilot efforts that examine the effectiveness of social outcomes evaluation frameworks, including the knowledge, attitudes and practices (KAP) study method. This report focuses on the KAP study carried out in Dakota County Minnesota, and the results of that study.

The goal of the KAP study was to learn whether the KAP method would provide insight into the effectiveness of the winter maintenance training program, specifically whether trainees have adopted and maintained recommended practices. Benefits of the KAP method are that it is relatively quick and inexpensive to develop and administer, although it wasn't known if would prove useful in this particular circumstance. The KAP method is a relatively new way of measuring social outcomes in water quality projects in the United States. The Dakota County Winter Maintenance Training KAP represents an attempt to show measureable change in individuals' knowledge, attitudes and practices as

related to the application of de-icing chemicals by county workers. The resulting data from this effort is significant and should lend value to the use of this methodology by other socially-focused NPS water quality improvement projects in Minnesota and across the United States.

### **Methods**

The Dakota County KAP study is one of approximately eighteen conducted to date by the WRC on a variety of water quality projects in Minnesota. The KAP method originated at least sixty years ago in international public health and epidemiology programs in Asia. Today, KAP studies are commonly used in water quality programs around the world, especially in water sanitation and community health projects. The method is not well known in the United States outside of public health and medical research (Eckman 2008 and 2010).

KAP studies can be used to plan a project, learn more about a specific audience, design educational and outreach strategies, and to identify barriers and constraints. KAP is an applied social science research tool that can also be used to evaluate the impacts of environmental projects on intended audiences. The KAP study design used in Dakota County was based on a literature review conducted in 2008 (Eckman 2010), and on experience drawn from other KAP studies in Minnesota (see especially Eckman and Walker 2008). Typically, KAP questionnaires are custom-designed for each situation and project, and the content reflects specific knowledge, attitudes and practices values for each project.

The questionnaire was developed by first discussing the gaps in understanding about driver knowledge, attitudes and practices about winter maintenance. Discussions with staff from Dakota County and Fortin Consulting identified specific best management practices to protect water resources from de-icing chemicals. The Dakota County KAP questionnaire was jointly developed by Fortin Consulting, and staff from the WRC. Questions were designed to assess the knowledge, attitudes and practices of the county snowplow drivers, before and after the winter maintenance training provided by Fortin Consulting. For example:

*Knowledge:* “I know the practical working temperatures for de-icers.”

*Attitudes:* “I have a positive attitude toward improving our winter maintenance operation.”

*Practices:* “I measure pavement temperature.”

A draft questionnaire was then developed and refined, then pre-tested.

**Your Winter Maintenance Practices**

Please place an "X" in the column that best describes your current practices.

Recommended Practice	Yes	No
There is a winter maintenance policy for my organization		
I understand and follow the winter maintenance policy		
I document my winter maintenance actions		
The policy encourages plowing before two inches of accumulation		
All equipment is calibrated annually		
Equipment is calibrated for each type of de-icing material used		
Equipment is calibrated for each setting on manually controlled sanders		
There is a calibration card in trucks with manually controlled sanders		
I have ground speed controlled sanders - the auger sensor is installed and working		
I have ground speed controlled sanders - During calibration I have set the computer speedometer to match my truck's speedometer		
I know the practical working temperatures for de-icers		
I select a de-icer/abrasive that will work for my pavement temperature and trend		
I measure pavement temperatures		
I use a weather forecast system or website like RWIS to determine when to sand		
I use an application rate chart to determine the amount of sand to apply		
I avoid using road salt when pavement temperatures are above 15 degrees F		
I drive as slow as possible when applying salt or sand		
I try to apply salt to the center line or shoulder of the road		
I Anti-ice before the storm		
I plow before applying de-icers to avoid dilution of chemical		
I don't plow snow directly into the storm drain, pond or wetland		
I wet de-icers before application to reduce a pretreated salt		
I minimize the use of de-icing during a heavy snowstorm		
I avoid salt/sand mixtures		
I avoid overfilling trucks to the pile instead of applying extra to roads		
I clean up trucks before leaving the storage area		
I store salt/sand on a hard surface so that the debris can be recovered in the spring		
I store salt/sand under cover		
I sweep off from my salt storage back into the storage or into another containment		
I never dump salt/sand into the storm drain, pond or creek		
I sweep up winter sand and dispose of it properly		
I attend post-storm meetings		
I attend winter maintenance training classes		
I seek out new methods, equipment and de-icers to lower environmental impacts of winter maintenance		
I have a positive attitude towards improving our winter maintenance operations		

*Dakota County KAP study questionnaire*

The first-round KAP study was done at a training workshop in September 2008. Thirty-two Dakota County snowplow drivers took the survey before receiving the winter maintenance training. They were asked thirty-five questions about their winter maintenance practices. The survey was repeated fourteen months later, after two snow seasons had been completed. Only responses from the snowplow drivers that took both the pre- and post-surveys were analyzed (part-time and seasonal employees were not included in the final analysis). This was possible due to a numbering system on the questionnaires so that pre- and post-survey data could be compared. The survey data was kept secure and confidential by the researchers.



*Taking the second-round KAP study, September 2010.*

## **Results**

A summary of the survey questions and results of the pre- and post-surveys can be found at the end of this report. The first-round survey (administered in September 2008) showed that while general knowledge and practices of the snowplow drivers were relatively good, there was some room for improvement.

Although the first pre-training survey was not intended as a stand-alone survey, some interesting observations could be made. For example, everyone in the class was aware that a winter maintenance policy existed for their organization and no one was anti-icing before the storm. There was less agreement on areas that required independent judgment, such as “I minimize the use of de-icers during a snow storm.” Sixty percent of respondents agreed with this statement.

The second survey, administered in November 2010, both positive and negative changes were evident and easily seen by comparing the pre and post training KAP data. The majority of responses to questions showed general improvements, particularly for winter maintenance practices. Of the thirty-six questions in the KAP study, general KAP values moved in the following directions:

Knowledge questions (n=3):

Negative change: 1

No change: 1

Positive change: 1

Attitude questions (n=1):

Negative change: N/A

No change: N/A

Positive change: 1

Practices questions (n=32):

Negative change: 5  
No change: 4  
Positive change: 23

Several questions showed significant improvements in knowledge and practices. For example, 60% of plow drivers in the 2008 survey responded that “I minimize the use of de-icers during a snow storm” while 96% reported doing so fourteen months later (a 36% improvement). Responses for “During calibration I have set the computer speedometer to match my truck’s speedometer” jumped from 40% in 2008 to 73% in 2010 (a 33% improvement). Responses for “I use an application rate chart to determine the amount of salt/sand to apply” increased from 35% in 2008 to 76% in 2010 (a 41% improvement). In the pre-survey only 27% of drivers reported avoiding using road salt when pavement temperature is below 15 degrees F; this increased to 88% in 2010 (a 60% improvement).

*The goal of the training is to reduce the amount of road salts used, while still maintaining the same level of service. The KAP data indicate that the training was successful in changing driver knowledge and practices, and that the KAP study method was effective in documenting those changes.*

The study did not quantify the actual amount of chemicals applied by each driver; rather the drivers *self-reported* a change in their practices. Other Minnesota KAP studies have used observational methods to verify the self-reporting of respondents on their actual practices. Since the training focused primarily on improving driver knowledge and practices, only a few attitudes questions were included in the survey. These values also shifted in a positive direction.

Results from the second KAP survey showed that knowledge and practices improved overall for the majority of questions, although the six listed below showed a slight decline:

“I document my winter maintenance actions declined from 73 to 69% (-4%).

“The policy encourages plowing before two inches of snow accumulation” declined from 92% to 84% (-8%).

“Equipment is calibrated for each type of de-icing material used” declined from 92% to 88% (-4%).

“I have ground-speed controlled sanders – the auger is installed and working” declined from 84% to 77% (-7%)

“I plow before applying de-icers to minimize dilution of the chemical” declined from 96% to 92% (-4%).

“I avoid salt/sand mixes” declined from 72% to 68% (-4%).

Given the small sample size (n=26), it is important to note that just one or two responses could have reduced the percentages. However, the KAP results for these six questions point to specific areas where either supplemental training or clearer department policies could result in better outcomes. These slight declines, however, do not minimize the fact that for virtually all other questions, KAP values shifted in a positive direction or were unchanged.



*One ton of salt (about one scoop) will contaminate about 659,000 gallons of water after it dissolves and is carried by rain into lakes and rivers.*

*Source: Fortin Consulting*

We carried this one step further and cross-checked the KAP results against the total quantity of de-icing chemicals used in each snow event by all drivers (not individual quantities applied by each driver). Dakota County shared their maintenance records with us. During the winter season before training an average of 405 tons of salt per snow event was used. In the winter season following training, an average of 355 tons of salt per snow event was used, 50 tons less per event than the previous year. This correlates to about 40 million gallons of freshwater protected from chloride contamination per snow event.<sup>1</sup> The County’s data confirms that the KAP results showing positive changes “on paper” were valid. It also provided evidence that the training was effective in changing driver practices.

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<sup>1</sup> 1 tsp of road salt permanently pollutes 5 gallons of freshwater; 10 tons pollutes about 8 million gallons; 50 tons pollutes about 40 million gallons (amount they reduced per snow event); 50 tons x 27 events = 1,080,000,000 gallons of freshwater that Dakota County protected in the year we conducted the second round of KAP.



Since this study was conducted at one organization, it was easy to see where change was needed to improve productivity or where operating efficiencies existed. This would be impossible with a mixed group (e.g. from several counties). For example, one problem made visible with just the pre-survey was that many drivers did not know that their trucks were calibrated. This was because a different division of the County calibrates trucks. In order to increase driver confidence in their trucks to deliver chemicals at an accurate rate, the supervisor needed to keep them informed when their trucks were calibrated by other employees. The supervisor assumed the drivers would know this but in fact they did not. The KAP study was able to flag this as a problem, and the County was able to take corrective action.

The winter maintenance training was partly responsible for a cost savings to Dakota County. For the 2008/2009 season the county used 14,175 tons of salt for thirty-five snow events, averaging 405 tons per event. For the 2009/2010 season the county used 9,585 tons of salt for twenty-seven events, averaging 355 tons per event. This resulted in a reduction of fifty tons per snowfall event, (or twenty seven events).<sup>2</sup> County staff attributed the decrease in salt from 405 to 355 tons to the use of computerized sanders, the use of magnesium chloride, and to the winter maintenance training provided by Fortin Consulting.

### **Summing Up**

First, the pre- and post-training KAP study shows that the winter maintenance training was effective in changing specific practices and behaviors, and improving the knowledge of the county snowplow drivers. By adopting and maintaining the practices they learned in the training, the snowplow drivers were able to reduce the amount of public funds spent on the purchase of de-icing chemicals. The KAP study increased the visibility of the changes made by the plow drivers. The drivers have adopted better practices over two winter maintenance seasons.

*During the winter of 2009-2010 alone the Dakota County snowplow drivers prevented over one billion gallons of freshwater from being permanently polluted by de-icing chemicals.*

Second, the KAP study tool was effective in documenting those changes adopted by the crew, and pointing out a few areas where further improvements can still be made. Most other project evaluation tools don't assess current attitudes, practices and knowledge or changes in them, any of which can be barriers to success. In this case the KAP method was found to be very easy and cost-effective to use, and quite effective in documenting social outcomes and evaluation results. As a result of the training provided by Fortin Consulting, and the documentation gained from the KAP study, Dakota County was able to communicate their results to others. In return they received an Environmental

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<sup>2</sup> Documentation provided by Bob Egan, Dakota County Maintenance Engineer.



Leadership award by the Freshwater Society, presented at the 2010 Road Salt Symposium.

The authors of this report are collaborating in the preparation of a training program for state and local government staff in the KAP study method. On-line and classroom training modules will become available in 2012. Please contact the authors for more information.

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