

# Potential Solutions for Reducing Road Salt Use in New Hampshire

*A Report to the I-93 Salt Reduction Workgroup*



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And

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# Inside front cover with Agency and funding information

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## Part I. Potential Solutions for Reducing Road Salt

### *Project Background*

The New Hampshire Department of Transportation (NHDOT) intends to add four new lanes to the southern section of Interstate 93. As a condition of the 401 Water Quality Certification issued for the I-93 expansion, and pursuant to the Memorandum of Agreement between NHDOT and New Hampshire Department of Environmental Services (NHDES), NHDOT will fund NHDES to complete Total Maximum Daily Load (TMDL) studies of chlorides in the four impaired watersheds. The purpose of these studies is to determine the TMDL of chlorides to each watershed such that water quality standards for chlorides will be met. In addition, NHDES will develop an implementation plan to reduce chloride loads to the TMDL. The expansion of I-93 is expected to accelerate population growth in southern New Hampshire. This growth will increase road salt usage in the area which may cause other watersheds to be impaired for chlorides. Increasing chloride concentrations are a regional and national issue, and New Hampshire is now at the forefront of addressing this issue.

A Steering Committee including representatives from NHDOT, NHDES, the Federal Highway Administration, and the Environmental Protection Agency was created to guide the Salt Reduction Project. The NHDOT and NHDES have, in conjunction with the TMDL study, also established a Salt Reduction Workgroup. This report on *Potential Solutions for Reducing Road Salt Use in New Hampshire* to the Salt Reduction Workgroup summarizes the findings from:

- Face-to-face interviews conducted with the Workgroup members;
- Workgroup meetings;
- Literature and internet research; and
- Focus groups with the driving public.

The focus of this report is on possible solutions to reduce salt usage on roadways and parking lots. All material presented in the report is oriented to the impacts of reducing salt on roadways and parking lots and the social, economic and safety considerations of the traveling public and the surrounding communities, as well as the anticipated positive impacts on the natural environment. This report will be used to guide the remainder of this comprehensive research and facilitation project involving the Salt Reduction Workgroup, and will guide the *TMDL Implementation Plan* being created by NHDES.



## *Identified Solutions*

The various research methods summarized in this second report to the I-93 Salt Reduction Workgroup reveal the need for a comprehensive approach to the issue of road salt reduction on existing surfaces. As we look for ways of reducing the usage of road salt on roadways and parking lots it is clear that the issue of salt loading is complex and has no single solution. The search for possible solutions becomes even more complex as we consider the variety of surfaces being treated in each of the Watersheds, the varying winter weather conditions, and future development pressures. This problem must be addressed at all levels by a variety of Stakeholders (local and state leaders, maintenance professionals, and the public).

### **Several possible solutions were identified by the multiple research methods used during this project:**

- Training on treatment practices for maintenance professionals (public and private) to ensure appropriate storage and application of road salt;

The Minnesota *Winter Parking Lot and Sidewalk Maintenance Manual* and the *Minnesota Snow and Ice Control Field Handbook for Snowplow Operators* provide a starting point for new training materials and initiatives targeting public and private winter maintenance professionals. Both documents address issues from storage through application, and provide new information and practices that will result in road salt reductions. The creation of similar materials and training opportunities within New Hampshire is an important implementation strategy that should be pursued.

- Equipment and infrastructure upgrades including new decision making tools for winter maintenance professionals;

Implementation of this solution will vary based on the equipment and infrastructure needs of the community, agency, or organization. In some instances the need will be for new trucks and equipment that can be more accurately calibrated to deliver the appropriate treatment level for each winter weather event. Others may have a more basic need for salt storage, or connection to online weather services and decision making tools. Reports from Environment Canada and the State of Minnesota cited in Part 2.D. of this report provide additional details and direction that may be useful to the communities and agencies in New Hampshire working to reduce their road salt use.

- Behavior change programs to assist with voluntary and mandatory approaches both for the driving public and maintenance personnel;

Social Marketing initiatives are needed within New Hampshire to assist with the necessary behavior changes related to surface treatment and winter driving. Although there has not been a great deal published in this area that specifically deals with road salt reduction efforts there are many similar projects addressing other environmental and social issues that may serve as models. Altering public demand for winter road maintenance includes changing the necessity for bare pavement during storm events.

One technological solution that may prove helpful with education and behavior change efforts is a winter weather severity index advocated for by Montana State University. This tool could build on the Roadway Weather Information System (RWIS), currently being used by some maintenance professionals in New Hampshire to make decisions on treatment procedures, to communicate roadway conditions and highway safety to the driving public.

- Lower speed limit during storm events; and

Similar to the State of Maine and others that enforce a lower travel speed during winter storm events, the State of New Hampshire could develop and pass a state law requiring such a reduction. Research demonstrates that reduced winter speed limits will reduce the incidence of accidents on winter roads, which will then reduce the need for reliance on road salts alone to achieve the goal of winter road safety. (RiverSides Stewardship Alliance – 2005)

- Mandatory use of snow tires for the public.

The current popularity of all-season radial tires has resulted in a situation where fewer tourists and New Hampshire residents use winter tires. The reduced use of winter tires is part of the reason road maintenance authorities feel the need to maintain “bare pavement” objectives. Education initiatives and regulations related to the use of snow tires would more actively involve the driving public in salt reduction efforts while ensuring safety on New Hampshire roadways during winter weather events.

Although each one of these alternatives may contribute to the needed road salt reductions a blend of approaches will need to be used to achieve the necessary level of reductions in the identified watersheds. A commitment to this reduction is required at all levels by a full range of stakeholders.

The local maintenance professionals involved with this study have also expressed an interest in more data on the actual impacts of salt on the environment, recommended treatment levels (per lane mile and per acre), and salt reduction success stories from around the state of New Hampshire. Some of this information may become available as part of the TMDL studies and the pending TMDL Implementation Plan, but the remainder will take time and an ongoing commitment to road salt reduction in New Hampshire.

## *Additional Solutions for Reducing Road Salt Use*

A number of additional solutions have been identified by this study effort beyond the five overarching solutions presented on the previous pages. They have been organized under common implementation themes that will contribute to a reduction of the road salt applied to roadways and parking lots, but many of these solutions meet the needs of multiple themes.

### *Best Management Practices, Techniques, and Technologies*

The following solutions provide opportunities to reduce salt usage in the watersheds through new practices, techniques and technologies.

- **Development of local design standards that limit impervious surfaces and require the use of porous pavement and other infrastructure that enables a reduction of road salt use.** The UNH Stormwater Center could be an important resource for education and implementation under this approach. This is an opportunity for municipalities to make changes within their zoning, site plan review and subdivision regulations.
- **More costly, but effective, deicing materials might be an option on the private parking lots.** Although not necessarily an option for state and local routes, these materials may allow existing and future private lots to meet the necessary reductions without changes to their infrastructure (parking lots, roads, and drainage). This is especially important considering the majority of road salt loading within the watersheds is from private facilities.
- **Create additional public transportation alternatives.** This provides an opportunity to the driving public during storm events, and also contributes to several objectives the watershed communities are trying to address relative to smart growth and greenhouse gas reductions year-round.
- **Salt credit trading and other incentives to consider in addition to regulations.** As salt use is restricted at the local level there may be an opportunity to develop a salt credit trading system that would provide options to the private sector as they work to bring their maintenance activities into compliance.

### *Opportunities for Behavior Changes*

The following solutions provide opportunities to reduce salt usage in the watersheds through behavior changes.

- **Engage employers and delay or cancel work related activities during inclement weather.** Winter maintenance issues are driven to a degree by the pressure to keep roads open for the driving public within and immediately following all storm events. Efforts to reduce the number of vehicles on the road during and immediately following a storm event allows for different treatment options and a reduction in the amount of road salt used.
- **Cooperation and flexibility from the school districts on delaying or cancelling operations, and/or better equip the buses to handle winter driving conditions.**

The same is true for trips related to school attendance. School buses are most often the least equipped vehicles for winter driving, and they are tasked with transporting children. Further cooperation from the school districts in the Watersheds would allow for different winter maintenance practices during storm events, and as a result could reduce the amount of road salt being applied. Another approach would be to better equip these vehicles with automatic tire chains similar to those used on emergency vehicles.

- **Pass a law requiring all drivers to take a winter weather driving course.** Because the driving public has been identified as having a central role in this issue it would make sense to provide all drivers with a better understanding of how to plan their trips and drive during winter storm events.

### *Monitoring Road Salt Usage*

The following solution provides an opportunity to reduce salt usage in the watersheds through the use of an accounting system that would track road salt use.

- **Develop a local accounting system that will provide the means for tracking road salt use in each community.** Although each community could design and implement its own accounting system the development of a state model would be beneficial, and may encourage a format that will also allow for analysis on a watershed basis. A very similar recommendation resulted from the Shingle Creek Chloride TMDL Implementation Plan in Minnesota, and the Minnesota Winter Maintenance Manuals identified one approach for manually recording and tracking the amount of road salt used for each event. This solution could also be automated to some degree.

### *Regulatory Approaches*

The following solutions provide opportunities to reduce salt usage in the watersheds through regulatory changes.

- **Adopt regulations of some type to dictate the level of service during winter maintenance operations.** This solution will require the adoption of new enabling legislation which is being considered at the state level. Then municipalities would have the opportunity to work with private property owners to track and reduce the use of road salt in the community.
- **Limit the liability on private lots where the private contractors and property owners are open to lawsuits.** In order to reach the identified reductions of road salt use and accommodate future development it may be necessary to find a mechanism for limiting the liability of property owners and maintainers as long as they are following the recommended treatment guidelines provided by the state. The ski industry may serve as a model for limiting liability.
- **Create “No Salt” areas.** This solution will require the identification of locations where no salt should be applied during winter storm events due to their proximity to natural resources, and research into the regulatory approach needed to create these areas in New Hampshire. This is a technique that has been applied in other states including Massachusetts.

### ***Evaluating and Documenting Success***

The following solutions provide opportunities to document and evaluate the level of success of road salt reduction efforts in the watersheds.

- **Monitor water quality and road safety issues.** This solution will provide feedback over time on the effectiveness of efforts to reduce the use of road salt in the Watersheds while maintaining safety for the traveling public. Several of the resources identified in Part 2.D. of this report stressed the importance of long term water quality monitoring, but most did not suggest monitoring changes in traffic volumes and safety to evaluate the effectiveness of new policies related to road salt reduction.
- **Identify other ways of documenting the success of these salt reductions.** Efforts to document successful changes to public and private winter maintenance operations in New Hampshire are needed. There is a lack of detailed information on alternative treatment alternatives used in New Hampshire to date such as pre-treating I-93 with Brine. Detailed documentation of successful New Hampshire examples will assist with changes to winter maintenance practices. This may be possible initially as a requirement for any funding to reduce road salt use, and in cooperation with the Technology Transfer (T<sup>2</sup>) staff at the University of New Hampshire.

## Part II. Detailed Review of Methodologies and Findings

This project was designed to identify approaches that could potentially reduce the use of chlorides and the negative impacts associated with their use in the I-93 corridor. To achieve these goals multiple social research methods were used to compensate for and capitalize on the strengths and weaknesses of the various methodologies employed. They include:

- *Survey Effort* – a standardized survey instrument used to structure data collection on topics of interest from members of the Workgroup. Qualitative and quantitative data were created using three types of questions; yes/no responses, scaled responses (both nominal and ordinal), and open-ended responses
- *Workgroup Meetings and Discussions* – a format that included presenting new information to the Workgroup and facilitating open discussions to collect feedback from the participants.
- *Literature and Internet Research* – a review of available documents concerning national and international efforts to reduce the use of chlorides as a winter road treatment.
- *Focus Groups* - a qualitative method of inquiry that used a predetermined set of topics and open-ended questions, administered by a moderator, to guide discussion amongst a small group (between 5-10 people).

### A. Broad Research Questions Guiding the Project

The broad research questions used to guide this project include, but are not be limited to, the following:

- a. Identification of specific best management practices, techniques, and technologies to reduce salt application to roadways and parking lots;
- b. Identification of behavior changes needed by the driving public, safety service personnel, elected officials, and road maintenance staff to reduce salt application to roadways and parking lots and the willingness of these parties to change their behavior;
- c. Identification of the optimal design for targeted outreach, education, and hands-on technical assistance programs to all corridor communities to reduce salt application to roadways and parking lots, including coordination with existing and future efforts and other statewide or local initiatives (i.e. I-93 Community Technical Assistance Program, UNH Technology Transfer Program, NHDOT I-93 website, etc.);
- d. Identification of the optimal methods necessary to obtain accurate information on salt usage for winter road maintenance by all applicators (State, private, municipal, other);

- e. Identification of regulatory approaches to reduce salt application to roadways and parking lots;
- f. Identification of appropriate evaluation criteria for technical funding requests from Workgroup members to reduce salt application to roadways and parking lots;
- g. Identification of a strategy for evaluating and documenting success of sustainable behavior change to implement salt load reductions.

## **B. Survey Effort and Findings**

Dr. Brian Eisenhauer of the Center for the Environment and Steve Whitman of Jeffrey H. Taylor and Associates developed a standardized survey instrument to structure data collection on topics of interest from members of the Workgroup. The questionnaire was reviewed and approved by members of the Steering Committee, and 36 face-to-face interviews were conducted with Workgroup members and other key informants (defined as professionals who are active in the winter road maintenance field) using the standardized survey instrument. All but three of the agencies or people contacted for interviews participated in the study. The interview protocol consisted of three types of questions:

- yes/no responses
- scaled responses (both nominal and ordinal)
- open-ended responses

Together, these three types of questions provide more complete data than would an interview consisting of simple yes or no responses {Singleton, 2005:337}. Interviews lasted from 30 minutes to more than two hours, and in the course of the interviews extensive hand-written notes were taken. At the conclusion of the interview process, the results were coded, checked for completeness, and verified by the researcher.

The data from close-ended questions was entered into a statistical database. Statistical software (Statistical Package for the Social Sciences (SPSS)) was then used to describe the data in univariate (single variable) and bivariate (multiple variable) analyses, so as to assess potentially important relationships, and, furthermore, to determine if stakeholders with varying professional perspectives regard the perceptions of, and the barriers to, the reduction of road salt differently. Questions were developed and their coding was conducted following appropriate survey techniques for the social sciences to ensure the validity and reliability of findings (Dillman 2000).

Responses to the open-ended questions were recorded by the interviewer, and the notes were reviewed individually and recorded using a coding sheet that followed the interview protocol, based on the questions used to guide this research developed by the Steering Committee, the Workgroup, and the project team. The coding sheet was used to organize findings from the interviews. Once the data were organized according to the topics identified, another stage of analysis was performed in which the information was analyzed into conceptual categories and patterns that emerged from the data itself (Miles and Huberman 1984) and were relevant to the research questions (Glaser and Strauss 1969). Findings are presented in the form of summary comments and identifications of key issues uncovered in the interviews relevant to each of the topical areas examined.

In combination, the analysis of the results conducted using SPSS and the qualitative information provide usable data to address the research questions guiding this study. Key findings are highlighted in this report, and the full content of the analysis appear in the Appendix of Report 1,

*Results of the Workgroup Interviews*, to the Salt Reduction Workgroup. The implications of these findings are addressed in the Conclusion.

## **Key Conclusions from the Workgroup Interviews**

### ***Best Management Practices, Techniques, and Technologies***

- The surfaces being treated by the state/local/private maintenance crews are quite different, and can have vastly different conditions and needs during storm events.
- More training is needed overall. There may even be a need to go on the road to the towns. All new information should be delivered by a peer from the same field.
- Solutions should be focused on training, equipment and infrastructure upgrades, and behavior changes, rather than finding a new product to apply to surfaces.
- In general, if information is well presented by unbiased people, the respondents were open to new information on alternatives.

### ***Behaviors Relative to Application, and Communication Strategies***

- Most everyone recognizes that the general public is key to resolving this issue.
- Changes in the expectations of winter road surface conditions seem to be needed, and the message needs to come from all levels.
- Most road maintenance professionals are open to changes, but need them to come as a directive that will be backed by the town (regulation, policy change, etc.).
- Given their different areas of responsibility, there is the potential for conflict between some police officers and road maintenance staff during storm events.
- The private sector winter maintenance companies are very transient. The structure of their contracts often dictates the degree of treatment they provide.
- Because the private sector performs winter maintenance under annual contracts, permanent storage or cover is seldom established.
- Towns are having trouble attracting contractors due to the rising costs of operating such a seasonal service.
- Town staff that get trained on new information and technology related to winter maintenance are often constrained in their town financially and don't get to implement the new approaches.
- Black and dry road conditions are expected by most stakeholders. Although there is no such official policy here in New Hampshire, that expectation has been created over time.

### ***Salt Usage Data***

- More data is needed on the impacts of salt in New Hampshire, and on recommended surface treatment levels.
- Improvements need to be made in the reporting of salt usage, and in communicating why this data is important.
- Currently salt usage data is viewed as most critical for budgeting and purchasing needs.
- Although most decision making on surface treatment follows a similar process, the tools available vary quite a bit. The State has access to advanced decision making technology for some routes, while some of the smaller towns don't even have access to radar on the Internet.

### ***Regulations***

- There were many concerns over how regulations will be implemented, but the majority felt that regulation was the only way to change practices.

- Depending on the structure of the regulations, and the salt application reductions required, many Workgroup members felt that some funding will be necessary for implementation.

### ***Funding***

Although there may be a need for some general distribution of funding, most Workgroup members felt that the funding should be used to address problem areas and to create positive examples of progress in salt reduction in New Hampshire.

## **Survey Effort Conclusions**

The most popular treatment and management solutions identified for reducing salt in the I-93 watersheds included:

1. Training;
2. Equipment and infrastructure upgrades; and
3. Behavior change both by the driving public and maintenance personnel.

A combination of approaches is considered necessary to reduce the current level of salt used on all roadway and parking surfaces.

In conclusion, it is clear from this portion of the Salt Reduction Study that the surfaces being treated throughout the watershed areas vary greatly, and often call for different approaches to treatment during storm events and general winter weather conditions. This is not a one size fits all situation. Most of the respondents that participated in **this process recognized the general public as having a central role in this issue of treatment levels**, and as having expectations of high levels of service on all roadways during and immediately following storm events. The increase in treatment quality and response time has created an expectation that roads will be open and passable most of the time.

The analysis of responses to the research questions, by profession, concluded that there are far fewer differences across these groups of stakeholders than anticipated. These groups view the issues in question in very similar ways, which means more targeted educational efforts and information exchange is possible, as the various groups have more of their views and understandings in common than might be assumed before the comparisons were conducted.

The most popular treatment and management solutions identified for reducing salt in the I-93 watersheds included **training, equipment and infrastructure upgrades, and behavior change.** There was not support for one product that could simply take the place of road salt. A combination of approaches were considered necessary to reduce the current level of salt used on all roadway and parking surfaces. All of the stakeholders were open to changes, but some will need a strong directive in order to proceed with significant changes to their existing operations.

It is also clear that **more data on the impacts of salt on the environment in New Hampshire is needed, in an easily accessible format, to all stakeholders and the public.** More data and understanding is also needed on existing reduction efforts and alternatives being experimented

with in New Hampshire. Brine is a perfect example of this. Although all of the respondents were aware of the use of brine on the Interstate, most were unsure of its success.

Another long term concern related to winter maintenance is the hiring of qualified contractors. Rising operating costs (fuel, insurance, etc.) and shorter and more unpredictable winters are resulting in fewer companies and individuals who will enter into this seasonal profession. This will be a growing challenge for all treatment areas (state, local, and private).

The analysis of responses to the research questions by profession concluded that there are far fewer differences across these groups of stakeholders than anticipated. These groups view the issues in question in very similar ways, which means more targeted educational efforts and information exchange is possible, as the various groups have more of their views and understandings in common than might be assumed before the comparisons were conducted.

Lastly, as potential regulatory solutions are evaluated it will be important for the regulators to consider how they will be implemented, and what costs will be passed along to the local communities and private property owners. The respondents expressed an **interest in any incentives that can assist with a transition to new winter maintenance practices**. Included in that is a **need for this problem to be addressed at all levels, and by a partnership of stakeholders that include local and state leaders, the general public, and road maintenance professionals**.

#### Potential Solutions Identified by the Survey Effort:

- A combination of approaches is considered necessary;
- The problem must be addressed at all levels by a variety of Stakeholders (local and state leaders, maintenance professionals, and the public);
- Training on treatment practices for maintenance professionals (public and private);
- Equipment and infrastructure upgrades;
- Behavior change programs both for the driving public and maintenance personnel;
- Incentives to assist with the transition to new winter maintenance practices;
- More data – impacts of salt, recommended treatment levels (per lane mile and per acre), and salt reduction success stories; and
- Regulations of some type.

## C. Workgroup Meetings and Findings

Beginning in July of 2007, Jeffrey H. Taylor and Associates has been working with the Salt Reduction Study Steering Committee to convene meetings of the Salt Reduction Workgroup. A total of five Workgroup meetings will take place before December 2008 in order to complete each of the research and reporting components of this study, and to develop criteria for the Salt Reduction Grant Program. The minutes for the first of these Workgroup Meetings have been included in the Appendix.

### Workgroup Meeting One - July 25, 2007

The first Workgroup meeting included four presentations which provided new or updated information to the members of the Workgroup:

- *Presentation on the results of the workgroup member interviews regarding barriers to reducing salt use on roadways* - Steve Whitman of Jeffrey H. Taylor & Associates and Brian Eisenhauer of Plymouth State University's Center for the Environment.
- *Presentation on salt usage by private contractors in the TMDL watersheds* - Dari Sassan of Plymouth State University's Center for the Environment.

The most critical finding that resulted from this study is the significant amount of salt loading taking place on private surfaces in these two watersheds. Mr. Sassan presented the findings of his study and approximately fifty-eight percent (58%) of the road salt use is related to the treatment of private roads and parking areas.

- *Presentation on water quality data collected for the Total Maximum Daily Load (TMDL) study* - Phil Trowbridge, P.E., New Hampshire Department of Environmental Services
- *Presentation on upcoming focus group research* - Ben Amsden of Plymouth State University's Center for the Environment.

After the presentations, the Workgroup discussed many topics related to the material presented and how these findings may help achieve the needed salt reduction. Steve Whitman of Jeffrey H. Taylor and Associates facilitated this discussion. The comments generally focused on potential solutions, and largely on how regulations and funding will come into play. The main points of discussion included:

- Timeline for regulations once the TMDL is complete, and if implementation could be delayed or phased;
- Timeline for funding, and the projects that may qualify for funding;
- Timeline for behavioral change;
- Forcing versus leading change;
- Have regulations in place to dictate the level of service during winter maintenance, along with social marketing toward the public;
- Using the Workgroup over the next few meetings to develop the funding criteria;

- Questions related to money that could be spent on the private sector and private properties; and
- Salt credit trading and other incentives to consider rather than purely regulations.

### **Workgroup Meeting Two – October 29, 2007**

The second Workgroup meeting included four presentations which provided new or updated information to the members of the Workgroup:

- *Presentation of the TMDLs for Policy Brook and North Tributary to Canobie Lake - Phil Trowbridge of the New Hampshire Department of Environmental Services*

After this presentation by Mr. Trowbridge the participants discussed issues and opportunities related to making the required reductions to road salt use to meet the TMDLs. The Workgroup expressed a need to involve local Planning Boards in the discussion of implementation actions, if it is desired that future development not contribute to salt loads, and to view redevelopment projects as an opportunity to reduce surface treatment needs.

The Workgroup discussed several approaches for making the necessary reductions in road salt use, including:

- The continued use of technology and new equipment on state and local roads
- The use of pervious pavement (which requires less salt use) on new or reconstructed parking lots
- Town ordinances to require accounting of salt use on private parking lots

These suggestions generated discussion on the need for hiring staff locally to handle enforcement of new salt accounting ordinances that may be adopted. These positions could be funded by money received from the State to assist with implementation activities.

Other issues and opportunities suggested by the Workgroup include:

- More costly, but more effective, deicing materials might be an option on the private parking lots.
- Behavior change involving the driving public needs to be addressed.
- Need for training and certification of private contractors.
- School buses and the pressure to avoid snow days often drives treatment decisions. If more cooperation and flexibility could be available from the school districts, or if the buses could be better equipped to handle winter driving conditions, some reduction in treatment levels is possible.
- Enforcement was also identified as an area that could be expanded on, and a lower speed limit during storm events would be part of that approach.
- Mandatory snow tires was also discussed as a way to reduce the need for salt on the roads.

-Reducing the amount of loading on private parking lots (as a per lane mile calculation) is an area that deserves some attention. This may include a need to find a way to limit the liability on private lots, where the private contractor's and property owners are open to lawsuits. One suggestion was to examine the ski industry and the mechanisms they use for limiting liability.

- The development of local design standards that limit impervious surfaces and require the use of porous pavement, and other infrastructure, which will reduce the need for salt.

- *Presentation on Focus Group Research* - Ben Amsden of Plymouth State University's Center for the Environment.

Ben Amsden presented an overview of how the four focus groups were organized in Concord and Windham, the types of participants, and the major findings. A more detailed report on this process can be found in the *Focus Group Effort and Findings* section of this report.

Ideas expressed by the Workgroup upon conclusion of this presentation included:

- An effort is needed in the schools to raise awareness of the salt related issues.
- Several participants employed by DPWs discussed the need to require use of snow tires on private vehicles.
- There was also a suggestion that education efforts raise awareness of winter weather as a dangerous situation similar to other natural events, and possibly relate the loss of life to other events that are perceived as dangerous (floods, fires, etc.).

- *Summary of Internet and Literature Research* - Steve Whitman of Jeffrey H. Taylor & Associates

Steve Whitman presented an overview of the process used to collect data from various Internet and literature sources, and some of the major findings. A more detailed report on this process and the key findings has been included in the *Literature and Internet Research and Findings* section of this report.

The meeting concluded with a discussion of short-term education and funding opportunities, facilitated by Steve Whitman. This discussion included the current approach to developing funding criteria for the dispersement of funds, and the timeline for the draft criteria. The current thinking of the Steering Committee is to start circulating draft criteria, and to settle on a set of criteria by April of 2008. This will provide an opportunity for the local communities to demonstrate their commitment to salt reduction efforts, and to begin accessing funds for the development of a local approach to salt reduction on public and private roads and parking lots.

The participants expressed an interest in reviewing draft criteria as they become available. The discussion included an emphasis on engaging municipal boards in this discussion leading up to April of 2008, and ensuring that the funding can be used on these initial administration tasks (staff time, developing a salt accounting system, etc.). Municipalities would need a permanent funding source to maintain staff to manage salt inventories. Several participants expressed that

they cannot hire someone for two years with state funds and then lose those funds. Lastly, a participant commented that the distribution of funds must be related to the amount of area (roads and parking lots) in that community that receives treatment.

### Potential Solutions Identified at the 2007 Workgroup Meetings:

- Have regulations in place to dictate the level of service during winter maintenance;
- Salt credit trading and other incentives to consider in addition to regulations;
- The continued use of technology and new equipment on state and local roads;
- The use of pervious pavement on new or reconstructed parking lots;
- Town ordinances to require accounting of salt use on private parking lots;
- More costly, but effective, deicing materials might be an option on the private parking lots;
- Behavior change, social marketing, involving the driving public needs to be addressed;
- Need for training and certification of private contractors;
- Cooperation and flexibility from the school districts, and/or better equip the buses to handle winter driving conditions;
- Lower speed limit during storm events;
- Mandatory snow tires;
- Limit the liability on private lots where the private contractor's and property owners are open to lawsuits;
- Development of local design standards that limit impervious surfaces and require the use of porous pavement and other infrastructure; and
- An effort is needed in the schools to raise awareness of the salt related issues.

## D. Literature and Internet Research and Findings

The salt reduction project included a review of available documents concerning national and international efforts to reduce the use of chlorides as a winter road treatment. A literature and Internet search was conducted by Jeffrey H. Taylor Associates and Plymouth State University's Center for the Environment in accordance with the project scope of work in order to identify technologies, practices, outreach and grant programs, regulatory approaches, and social marketing methods that have been used to effectively reduce salt application to roadways and parking lots in communities in North America. Sources included internal communication documents, public records, reports from other municipalities and nations, and scholarly publications. In combination these materials provided the researchers with a basic understanding of the issues and their development over time.

The research did not uncover any significant surprises, but did find some sources that will be useful as the project moves toward implementation actions. The field of work on this topic is fairly narrow and recent. Many of the sources related specifically to road salt reduction efforts were created since the year 2000, and the older sources resulting from this search are generally on related (non-road salt) efforts that could be used to inform and develop effective approaches in New Hampshire.

A number of reports and studies were identified under each of the six topics, and several internet resources were also identified. Some of the findings included additional technical information on various chemical alternatives and mechanical equipment, successes and failures related to both, and new decision making tools. Various approaches to providing training to winter maintenance professionals are also identified.

Findings from a driver simulator study in Finland provide some insight into how to better inform users of road and driving conditions, and a couple of sources under *Social Marketing* offer voluntary and mandatory approaches involving the public. Overall voluntary approaches seem to be more promising when it comes both to the driving public and to road maintenance professionals. Exceptions would be winter speed limits and mandatory use of snow tires for the public, and appropriate storage and application of road salt by winter maintenance professionals.

The Canadian sources and others that appear to have been tackling this issue for some time also stress the importance of monitoring water quality and road safety data to determine the effectiveness of road salt reduction efforts.

Overall voluntary approaches seem to be more promising when it comes both to the driving public and to road maintenance professionals. Exceptions would be winter speed limits and mandatory use of snow tires for the public, and appropriate storage and application of road salt by winter maintenance professionals.

**a) Specific best management practices, techniques, and technologies to reduce salt application to roadways and parking lots.**

D'Itri, F, ed.(1992) . *Chemical Deicers and the Environment*. Boca Raton, FL. Lewis Publishers.  
Edited volume that discusses chemical de-icer technology and history in the United States and Canada. The main point is that ANY chemical products used for de-icing will present themselves in the environment at some point. So, a best practice along the lines of chemical alternatives to salt still need to be considered ecologically and environmentally.

Fischel, M. (2001). Evaluation Of Selected Deicers Based On A Review Of The Literature. Colorado Department of Transportation, HA8-20001/DV.  
[www.dot.state.co.us/Publications/PDFFiles/deicers.pdf](http://www.dot.state.co.us/Publications/PDFFiles/deicers.pdf)

This report contains a qualitative worker survey, consisting of questionnaires sent to 126 employees of the Colorado Department of Transportation and Roaring Fork Transit Authority who have daily contact with deicers. Of the 69 employees that responded to the survey, 26% reported minor symptoms including eye, skin, respiratory, and intestinal irritation. It was not possible, based on the qualitative nature of the survey, to determine whether the symptoms were related to deicer use. Based on a review of the literature, it is concluded that each of the deicers evaluated has both advantages and disadvantages, in terms of environmental effects, human health effects, cost, performance, and corrosion. Thus, the maintenance supervisor should evaluate the trade-offs in determining which deicer(s) to use.

Hodel, L. (2004). Safer De-Icing Chemicals. *Mother Earth News – The Original Guide to Living Wisely*. Issue 201, December.  
[http://www.plantops.umich.edu/grounds/pdf/Mother\\_Earth\\_News.pdf](http://www.plantops.umich.edu/grounds/pdf/Mother_Earth_News.pdf)

This article describes several alternatives to road salt including: Calcium Chloride, Magnesium Chloride, Potassium Acetate, and Calcium Magnesium Acetate Advantages, disadvantages, and costs associated with each are discussed.

Meegoda, J., Marhaba, T; and Ratnaweera, P. (2004). Strategies to Mitigate Salt Runoff from Salt Storage and Salt Truck Maintenance Facilities. *Periodical of hazardous, toxic, and radioactive waste management*, 8(4) 247-252. <http://www-ec.njit.edu/~meegoda/saltpaper.pdf>

This paper discusses collecting and filtering storm water runoff from maintenance facilities in order to remove salt, and lists several best practices to mitigate this runoff.

They include:

- roofed Salt Storage/Maintenance Facility
- enclosed Conveyors
- proper Housekeeping
- regular inspection of washing areas for wash pads, sediments, sump, oil separators, etc. for cleaning
- training and instruction to employees and contractors using the area
- display of signs to indicate the usage instructions and discharge instructions

- it is recommended to discharge all water in recycling discharge, or provide straw bales or gravel bags
- approved wash rack that is sloped to contain and drain wash water and constructed to prevent runoff and runoff should be used
- phosphate-free, biodegradable detergents should be used, when available
- installation of oil water separators, rain sensors, or canopies when required
- vacuuming truck interiors
- coating trucks with non-stick surface
- full-snow-berm drainage system (they didn't elaborate)
- retention ponds

An additional benefit of this piece is the lit review, which highlights the use of salt-brine, anti-icing, and the use of Road Weather Information Systems (RWIS) in winter as alternative to salt for road maintenance.

Rosenberry, DO; Bukaveckas, PA; Buso, DC, Likens, GE (1999). Movement of Road Salt to a Small New Hampshire Lake. *Water, Air, & Soil Pollution* 109(1-4).

Runoff of road salt from an interstate highway in New Hampshire has led to contamination of a lake and a stream that flows into the lake, through leaks in a diversion berm. Ground water is also impacted because of reversals of gradient during summer months, likely caused by trees. This could mean that strategies such as a diversion berm may not be sufficient.

**b) Examples of behavior modification programs for the driving public, safety services, elected officials, and road maintenance staff that reduced salt application to roadways and parking lots.**

Bouilloud, L., and E. Martin, 2006: A Coupled Model to Simulate Snow Behavior on Roads. *J. Appl. Meteor. Climatol.*, 45, 500–516.

To develop a decision-making tool for road management in winter, a numerical model resulting from the coupling of a soil model and a snow model was developed and validated using experimental results from a comprehensive experimental field campaign. This model permits the simulation of the snow behavior on a road according to snow and road types. Comparisons of experimental and simulated results for typical snowfall events or over the entire winter showed that the model was able to simulate road surface temperature, snow occurrence on the road, and snow-layer evolution with good accuracy.

Haynes, R., Pine, R., & Fitch, H. (1982). Reducing Accident Rates with Organizational Behavior Modification *The Academy of Management Journal*, Vol. 25, No. 2, pp. 407-416

This study evaluated the effectiveness of an intervention package (feedback, competition, and incentives) in reducing the accident rate of urban transit operators. Results showed a 24.9 percent reduction in accident rates, establishing a definite link between the intervention and reduction in accident rates, severity, and cost.

U.S. Department of Transportation. Intelligent Transportation Systems Benefits (2007). <http://www.itslessons.its.dot.gov/its/benecost.nsf/ID/ACB955B0B54AFFDF852569D5005617A6?OpenDocument&Query=BApp>

A driving simulator study in Finland indicated that drivers cannot accurately assess road surface friction, thus the use of adverse road condition driver support systems can assist drivers in assessing adverse road conditions and increase safety and travel speeds.

Strong, C., Shvetsov, Y., and Sharp, J. (2005) Development of a roadway weather severity index. Western Transportation Institute, Montana State University. [http://www.coe.montana.edu/wti/wti/pdf/426711\\_final\\_report.pdf](http://www.coe.montana.edu/wti/wti/pdf/426711_final_report.pdf)

This paper describes a research project to quantify the relationship between winter weather severity and highway safety, with the idea that motorists may tend to exercise greater caution when warned about the road conditions they may experience. The weather parameters that were examined account for some, though not all, of the variability in crash rates experienced on different highway segments. However, none of the variables relate to snow or ice depth on the roadway, roadway friction, presence of chemicals on the road surface, or similar factors. While these factors would be expected to correlate strongly with roadway safety, there was insufficient data for them to be included in the models.

**c) Outreach, education, and hands-on technical assistance programs that reduced salt applications to roadways and parking lots.**

Bouilloud, L., and E. Martin, 2006: A Coupled Model to Simulate Snow Behavior on Roads. *J. Appl. Meteor. Climatol.*, 45, 500–516.

To develop a decision-making tool for road management in winter, a numerical model resulting from the coupling of a soil model and a snow model was developed and validated using experimental results from a comprehensive experimental field campaign. This model permits the simulation of the snow behavior on a road according to snow and road types. Comparisons of experimental and simulated results for typical snowfall events or over the entire winter showed that the model was able to simulate road surface temperature, snow occurrence on the road, and snow-layer evolution with good accuracy.

Fortin, C., & Dindorf, C. (2006). Road Salt Education and Training for those Maintaining Parking Lots and Sidewalks - Final Report. <http://proteus.pca.state.mn.us/publications/roadsalt-parkinglottraining.pdf>

Evaluation of a training program for parking lot and sidewalk maintainers. Does not discuss effectiveness of curriculum, teaching materials, etc – instead discusses logistics of research program.

Fortin, C., & Dindorf, C. (2006). Winter Parking Lot and Sidewalk Maintenance Manual. <http://proteus.pca.state.mn.us/publications/parkinglotmanual-june06.pdf>

This manual is based on the Minnesota Snow and Ice Control Field Handbook for Snowplow Operators produced by the Minnesota Local Road Research Board and on the training materials for the Minnesota parking lot winter maintenance training class. The purpose of this manual is to deliver practical advice to those who manage parking lots and sidewalks. This manual will help winter maintenance professionals make better proactive, cost-effective choices in winter parking lot and sidewalk management while operating more efficiently and reducing their environmental impact.

Minnesota Local Road Research Board (2005). Minnesota Snow and Ice Control Field Handbook for Snowplow Operators.

<http://www.mnltap.umn.edu/pdf/snowicecontrolhandbook.pdf>

This field handbook is designed to help promote the understanding of the tools, best practices, and limitations for snow and ice control. The handbook also identifies when to use and when not to particular tools and practices. Overall, it encourages progressive changes in snow and ice control practices that will help you reduce salt/sand use and environmental impacts while meeting the safety and mobility needs of roadway users.

Minnesota Pollution Control Agency (2007). MPCA Road salt education program.

<http://proteus.pca.state.mn.us/programs/roadsalt.html#background>

Found that private applicators were receptive to training in terms of determining when and how much deicing material to apply. However, this site concedes that a major obstacle to the training is attendance.

Northwestern University (2007). 'Real-World' Road Salt Investigation Sparks Science Learning. School of Education and Social Policy.

<http://www.sesp.northwestern.edu/newsCenter/?NewsID=260>

This news feature describes how researchers at Northwestern recently received funding to develop instructional materials and train Chicago-area teachers for this project. The goal is to engage students in environmental science by investigating how road salt is dispersed and how it affects plants, animals, drinking water, cars and roadways. This project emphasizes hands-on investigations because the inquiry method has been shown to increase student motivation and science learning

Riverkeeper.org (2007). Policy Formulation, Road Salt Reduction.

[http://riverkeeper.org/campaign.php/watershed\\_policy/we\\_are\\_doing/1314](http://riverkeeper.org/campaign.php/watershed_policy/we_are_doing/1314)

Describes developing salt reduction practices and cost-effective alternative deicing practices in several locations within the East-of-Hudson Watershed. Includes application tracking, the installation of new temperature sensor equipment on highway department trucks, and public education campaign.

U.S. DOT FHWA (2005). Success in Stewardship monthly newsletter.

<http://www.environment.fhwa.dot.gov/strmlng/newsletters/dec05nl.asp>

This newsletter describes a variety of state programs including training, sophisticated weather information systems, equipment improvements, symposia. The newsletter also advocates for a standardized Winter Storm Severity Index that would allow managers to better compare and analyze storm events, and adjust quantities and types of materials used according to specific snow and ice conditions.

**d) Accurate monitoring programs for salt use by winter road maintenance applicators (private, municipal, state, other);**

Ontario Ministry of Transportation (2003-2004). Maintenance Technology Project.

<http://www.mto.gov.on.ca/english/transtek/m03-04/03-04fs.htm>

The Maintenance Technology Project supports the Operations Division strategic direction of promoting the use of leading-edge technology, materials and equipment for winter operations on provincial highways, to ensure that maintenance operations use road salt, plows and spreaders effectively in providing safe winter driving conditions.

While the Elsinore Patrol on Highway 21 in Owen Sound Area continues to be the focus of test and evaluation activity, the scope of investigations has increased by engaging Area Maintenance Contractors and other Managed Outsource areas as partners in technology evaluation throughout Ontario. **Specially trained staff and equipment are in place at Elsinore to monitor the safety and effectiveness of innovative products, systems and approaches using video cameras, environmental and friction sensors. These technologies measure effectiveness objectively and ensure that safe conditions are maintained while tests are in progress.** Testing equipment is deployed at scheduled times to facilitate evaluations in the partner-operated areas. Improvements to the test and **monitoring** equipment this year include a fully web-supported video surveillance and archiving system, improvements to friction trailers, and a fully enclosed salt storage and loading facility.

Environment Canada (2004). Code of Practice for the Environmental Management of Road Salts.

[http://www.ec.gc.ca/nopp/roadsalt/cop/en/rs\\_main.htm](http://www.ec.gc.ca/nopp/roadsalt/cop/en/rs_main.htm)

The Code provides an approach to monitoring and measuring progress in road salt use, the implementation of best management practices with respect to road salts, and the concentration of road salts in the environment. Information collected will be used in conjunction with additional winter severity weather data provided by the Meteorological Service of Canada, environmental monitoring data collected from case studies and water quality monitoring programs, and road safety data provided by Transport Canada to determine the extent and effectiveness of implementation of the Code of Practice. The code calls for monitoring of chloride concentrations and frequency of sampling at each sampling location, and other best management practices.

City of Madison, Wisconsin (2006). Report of the Salt Use Subcommittee to the Commission on the Environment on Road Salt Use and Recommendations.

<http://legistar.cityofmadison.com/attachments/6492.pdf>

The report includes recommendations to:

-Install GPS AVL technology to track trucks and collect accurate material usage. The cost savings from this item stems from improved efficiency in truck and material usage. The City Streets Division has budgeted to start installing these tracking units in its trucks starting in the 2006 season.

-Create a Sampling program with conductance monitors Provide monitoring program during critical runoff times to better define acute problem areas. Conduct extended monitoring of sodium and chloride levels in storm water runoff, lakes, and groundwater to provide sufficient data for expanded modeling program.

City of Toronto (2004). Salt Management Plan.

<http://www.toronto.ca/transportation/snow/pdf/02smp.pdf>

Some of the monitoring programs include:

- Annual audit of existing salt spreading practices and operations to determine what improvements should be considered,
- Annual inspection of salt storage facilities at all city yards and camps. Many minor deficiencies have already been corrected, and new measures are being proposed,
- Ensuring spreader controls are calibrated and accurate records are kept and how salt is handled at city yards, and
- Development of a chloride monitoring program by the Water and Wastewater Division to determine salt content in watercourses. Results will be submitted to the Works Committee on an annual basis.

Nova Scotia Department of Transportation and Public Works, and Jacques Whitford Environmental (2005). Nova Scotia's Salt Management Plan.

<http://www.tac-atc.ca/English/pdf/conf2005/s5/richard.pdf>

Groundwater Monitoring (as a Best Management Practice):

The Province, with funding from Environment Canada, has installed 3 groundwater monitoring wells at salt storage facilities located in salt vulnerable areas. The Province is also developing a sampling program to assess the amount of sodium chlorides entering the groundwater.

Stokes, P., Havas, M., and Brydges, T (1990). Public participation and volunteer help in monitoring programs: An assessment. *Environmental Monitoring and Assessment*. 15(3) 225-229.

Can't find deeper access to this article but the abstract indicates that it evaluates examples of public environmental monitoring. Perhaps the takeaway can be that the public has been used in the past for environmental monitoring activities, possibly involving road salt.

e) **Effective regulatory approaches to reduce salt application to roadways and parking lots**

Environment Canada. (after 1998). Socio-Economic Background and Options Study on the Canadian Salt Industry. <http://www.ec.gc.ca/nopp/roadsalt/reports/en/socio.cfm>

Voluntary approaches (such as codes of practice, guidelines and financial incentives) are usually more attractive than mandatory measures (such as performance or technology standards). They tend to have a lower direct cost impact on contractor firms, are easier to implement, and can result in a reasonable degree of environmental effectiveness over time. The use of voluntary codes of practice has been in effect over the last 25 years, as has the training of contractors by agencies to follow industry guidelines and the use of technical advances. Thus, **codes of practice and guidelines** are a suitable management option to bring about actions to broadly reduce the environmental effects of road salt.

City of Madison, Wisconsin (2006). Report of the Salt Use Subcommittee to the Commission on the Environment on Road Salt Use and Recommendations.

<http://legistar.cityofmadison.com/attachments/6492.pdf>

The report includes recommendations to develop ordinances for regulating both private and public salt use including training, certification and reporting requirements.

f) **Social Marketing**

McKenzie-Mohr, Doug, and Smith, William (2006). "Fostering Sustainable Behavior", New Society Publishers (Washington, DC).

While conventional marketing can help create public awareness, social marketing identifies and overcomes barriers to long-lasting behavior change. This ground-breaking book is the primary resource for the emerging new field of community-based social marketing, and an invaluable guide for anyone involved in designing public education programs with the goal of promoting sustainable behavior, from recycling and energy efficiency, to alternative transportation.

McKenzie-Mohr, Doug (2007). Fostering Sustainable Behavior. [www.cbsm.com](http://www.cbsm.com)

The "Fostering Sustainable Behavior" website was developed to assist individuals who design programs to promote sustainable behavior (e.g., recycling, water and energy efficiency, etc.). Its purpose is simple: to provide information that can enhance the success of their efforts. This website consists of six resources: an online guide which provides valuable information on designing and evaluating programs; a listserv and associated archive for sharing information and asking questions of others; and searchable databases of articles, downloadable reports, cases and graphics on fostering sustainable behavior.

City of Madison, Wisconsin (2006). Report of the Salt Use Subcommittee to the Commission on the Environment on Road Salt Use and Recommendations.

<http://legistar.cityofmadison.com/attachments/6492.pdf>

*Provide educational material and training for private applicators*

A salt reduction training program has already begun for private applicators in the Twin Cities. Development of the training program was paid for by the MNPLC. Response to the training has been very positive. We recommend the City of Madison sponsor training opportunities for private applicators. The training is available from Fortin Consulting, Inc. The report also recommends providing educational materials to homeowners.

RiverSides Stewardship Alliance (2005). Reducing Road Salts Use.

<http://www.riversides.org/index.php?cat=3&page1=8&page2=37>

The document advocates for several initiatives including introducing policies to achieve social change. By altering public demand for winter road maintenance, changes in the necessity for bare pavement policies and reduced road salts demand should result. Two societal factors are highlighted: mandatory snow tire installations on automobiles, and winter speed limits.

Due to the current popularity of all-season radial tires, it is estimated that only a minority of Ontario drivers use winter tires. The reduced use of winter tires is part of the reason road authorities maintain “bare pavement” objectives. Research demonstrates that reduced winter speed limits and increased winter tire use will reduce the incidence of accidents on winter roads, which will then reduce the need for reliance on road salts alone to achieve the goal of winter road safety.

Cottrell, Stuart P. (2003). Influence of Sociodemographics and Environmental Attitudes on General Responsible Environmental Behavior among Recreational Boaters. *Journal of Environment and Behavior*, 5 2003; vol. 35: pp. 347 - 375.

This study examined predictors of self-reported general responsible environmental behavior (GREB) among recreational boaters in Maryland in 1992. Findings show a relationship between cognitive (professed knowledge of environmental issues), affective (environmental concern), and conative (verbal commitment) components of attitudes with pro-environmental behavior. Multiple regression results show that two attitudinal variables explained 23.8% of total variance in GREB. Verbal commitment was the strongest predictor, followed by professed knowledge of environmental issues. Environmental concern was moderately correlated with GREB but did not contribute significantly to the regression model. When sociodemographics were added to the model, stand on political issues added another .2% to the variance explained. A path diagram (AMOS 4.01) was used to reexamine the GREB framework. Results model those of the stepwise regression procedures (23% variance explained) in SPSS, and the path diagram simplifies interpretation of structural relationships among variables in a regression equation.

Potential Solutions Identified by the Literature and Internet Research:

- A combination of chemical alternatives and mechanical equipment may be instrumental in achieving salt reductions in some locations;
- New decision making tools for winter maintenance professionals;
- Training winter maintenance professionals;
- Better informing users of conditions;
- Social Marketing to assist with voluntary and mandatory approaches involving the public;
- Winter speed limits;
- Mandatory use of snow tires for the public;
- Appropriate storage and application of road salt by winter maintenance professionals;
- Monitoring water quality and road safety issues; and
- Overall voluntary approaches seem to be more promising when it comes to the driving public, and road maintenance professionals.

## VII. Focus Group Effort and Findings

The focus group research was a qualitative method of inquiry that used a predetermined set of topics and open-ended questions, administered by a moderator, to guide discussion amongst a small group (between 5-10 people). The goal of the focus groups was not to generate consensus, but to generate as much discussion as possible about drivers' expectations in winter weather. This was accomplished by creating an open environment wherein people could express their views and react to the opinions of others. The focus groups attempted to approximate normal social interaction, and analysis of the focus group data made use of the ideas and quotes as expressed by participants themselves, thus producing findings with very high face validity (Morgan, 1996). The conversations were recorded and the data was analyzed using content analysis techniques to identify common themes, significant differences, and important insights that emerged across the four groups (Bertrand, Brown, and Ward 1992; Kreuger, 1988).

In all, 34 people participated in the four focus groups – seventeen each in Windham and Concord. The participants were enthusiastic, interested in the topic, and came prepared to share their opinions.

Plymouth State University's Center for the Environment was responsible for the design and implementation of the focus group research. Two focus groups were convened at the Nesmith Library in Windham, on October 4 and October 7, 2007. Two additional focus groups were held at the Plymouth State University's offices in Concord on October 10 and October 13, 2007. The participants were chosen in a first-come, first-served fashion from those who responded to public notices, NHDES and PSU press releases, list-serve notices, and media advertising. In all, 34 people participated in the four focus groups – seventeen each in Windham and Concord. The participants were enthusiastic, interested in the topic, and came prepared to share their opinions. Each brought a different perspective, informed primarily by their diverse backgrounds, which included (among others) truck operator, state employee, engineer, scientist, homemaker, retiree, and student. The majority of the Windham participants discovered the focus group opportunity through our advertisement in the Windham Observer, while a large number of the Concord participants learned of the focus groups either through word-of-mouth or the NHDES and PSU press releases. Each participant received fifty dollars for participating in the focus group.

Each focus group was designed to last approximately two hours. The discussion that took place in each focus group was based on a moderator's guide designed specifically for the purpose of gathering information about driver's expectations for winter road conditions (Krueger, 2000; Stewart & Shamdasani, 1993). The moderator's guide (attached in Appendix) was developed using findings from earlier stages of the research project, such as the literature review, the TMDL data, and the survey of road salt professionals. Using the moderator's guide in all four focus groups was essential, as it served to keep the topic at hand, therefore reducing interpersonal biases among the participants (Stewart & Shamdasani, 1993).

## **Focus Group Findings**

The Windham participants seemed to view the issue of changing driving behaviors and reducing road salt as strictly an environmental issue, while the Concord participants voiced a broader concern with the economic, political, and social impacts of the issue.

In each focus group, specific questions were created to gather information about driver's expectations for road conditions during winter weather, and their feelings regarding roadside water quality. However, the themes that emerged from the answers to these questions are complicated somewhat by a noticeable difference in opinion between the participants in the Windham focus groups and the participants in the Concord focus groups. Simply put, the Windham participants seemed to view the issue of changing driving behaviors and reducing road salt as strictly an environmental issue, while the Concord participants voiced a broader concern with the economic, political, and social impacts of the issue. These differences could be caused by the makeup of the groups – the Windham participants tended to reside in a narrow radius of southern, more affluent New Hampshire towns such as Windham, Salem, and Londonderry, while the Concord participants hailed from a wider, more blue-collar region including Franklin, Plymouth, Alexandria, and Claremont.

### ***1) Describe your driving routine and your expectations for wintertime road conditions.***

Participants expect bad road conditions in the wintertime, and are prepared to use extra caution while driving during winter weather. Across all four focus groups, this “extra caution” was described as a winter-weather routine that included reduced driving speeds, the allocation of extra driving time, and the use of different travel routes. Many participants saw themselves as capable winter drivers, with ample experience driving in adverse conditions.

The participants in all four groups expressed an over-arching public expectation for safe and accessible roads. Many suggested that the state has met this expectation, and therefore other drivers (particularly those from out-of-state) have developed a tendency to drive recklessly in winter weather. Additionally, participants expressed a general sense that the roads should be kept clear enough for participants to “get to work” but not necessarily kept clear for those who were driving for other reasons, such as running errands. Another finding from the focus groups suggests that participants have come to expect drastically different conditions (both better and worse) on the highways than they do on local roads. Additionally, most participants are aware that weather conditions are not uniform during a storm – in many instances it will be raining in Londonderry but snowing in Franklin.

It should be noted that each of the focus groups viewed road salt and water quality primarily as a state issue. Despite inquiries into participant experiences with parking lots, local roads, etc, most folks framed their opinions in terms of "the state should do certain things" or "the state needs to apply less salt." One of the more strident comments, “the state’s black-road policy is white with salt” was actually voiced word-for-word by two separate individuals in two different groups. Other responses from Focus Group participants included:

- “NH has done an incredibly good job keeping the highways clear, because then you’d cross the border and it would be such a mess you could barely get through. I’m talking 5:30 in the morning comparing the 2 states New Hampshire definitely beats Mass hands down.”
- “I think southern New Hampshire does a very good job of clearing the roads in a timely manner.”
- “I think driver inattention is a big problem – people are going much faster than they should be. They need to slow down, and enforcement maybe something that needs to take place in that area.”
- “People expect that I-93 is going to be black.”
- “So I evaluate it on a day-by-day basis and say, do I really want to spend an hour and a half of my day doing my commute that should take 25 minutes. I don’t know if everybody looks at it that way – they’re gonna want to drive 65 miles per hour whether the roads are snow covered or not.”
- “We have white roads, because they’re white with salt! Salt residue. Their black-road policy is such a misnomer to me.”
- “In the winter, I just lower my driving expectations. I expect the roads to be slippery in spots, snowpacked at times, you plan more time for your trip, you drive slower, I have an all-wheel-drive vehicle, I expect poorer driving conditions in the winter.”
- “I expect that when there’s a blizzard, the roads are going to be bad. But they’re never bad. They’re always completely clear.”

***2) What do you think would happen to the road conditions if applicators used techniques and materials other than road salt?***

The idea of using new technology to improve both road conditions and water quality was met with skepticism. Each of the four focus groups voiced a concern with the safety of new technologies - MTBE in gasoline was mentioned as an example of a new technology gone wrong. As noted above, regional differences (Windham vs. Concord) emerged, as the Windham focus groups worried about the environmental effects of new technologies while the Concord focus groups were more concerned with heightened costs and their impact on taxes and local budgets. “New technologies” mentioned in the discussions included both different products (such as brine or other chemical solutions) and different application tools (such as salt regulators or measurement units on trucks).

Participants across all four focus groups questioned why the focus was on new technology, instead of other options such as the additional enforcement of reduced speed limits, or the

creation of “no salt areas” such as those seen in watershed areas throughout New England, and the creation of additional public transportation. While participants acknowledged the dangers associated with enforcement techniques such as asking State Police troopers to ticket reckless winter drivers, they questioned why cameras, radar, or other tracking devices were not being considered as possible alternatives.

The most important theme that emerged from discussions of technology (and from the focus groups as a whole) is the need for (and interest in) education and information about road salt and its attendant impacts on water quality. On multiple occasions participants made statements such as “I think people would respond to this issue if they had more information” or “I had no idea salt was a problem, why don't they give us information along the lines of what we hear about recycling, global warming, etc.” Nearly every participant agreed that they needed more information about the issue before coming to a conclusion about the environmental and practical impacts of road salt reduction.

Other responses from Focus Group participants included:

- “There are some pretty heavy duty economic implications, especially here in New Hampshire. If the roads aren't good – the skiers don't come. If the skiers don't come, we lose our room and meals tax, we lose our gas tax, we lose our liquor sales, we lose our business profit tax....”
- “There's always resistance to change, especially if it is going to cost more. The biggest fear is changing something and having someone get hurt.”
- “The question is really what [the new technology] is. It's hard to think of it hypothetically, because like I saw in an ad, don't throw anything away because there is no “away.” Whatever you're using as an alternative, the same questions are gonna come up, unless you have a very specific plan.”
- “I'd be happy with just sand.”
- “I guess my preference would be to come up with alternative surfaces, that wouldn't be so impacted by the weather – that would be my preference to salt alternatives which may or may not bring their own issues with them.”
- “I'd like to see the chemistry as far as the types of chlorides that they are finding. In the southern tier they are going to try a brine application. That's fine, I've made pickles too. But, you've got to look chemically at what's being used and what's occurring and what in that environmental area is also playing in.”
- “Some use a mixture, and some just use sand, and I think it just depends on the road and the amount of people and what level of people live on that road, too.”

- “Most of these automatic sanders have a meter in the cab. That meter adjusts to the speed. I think they try to figure like 100 pounds per lane mile. I think that’s ridiculous, because you have a driveway, 12 feet wide, a mile long, 100 pounds wouldn’t even touch it.”
- “You gotta look really carefully at what you’re replacing it with. Like MTBE, the replacement in the gasoline. That was great, and then they realized oh it causes cancer.”
- “I think they should do some pilot testing, like they do with the spraying, before the storm. It makes sense to do that in a phased approach, not just replace everything all at once because then you may not be happy.”
- “See this is where the education comes in. I think there’s a lot of people that if we left here and said oh we’re going to use less salt, people would freak out. But if they told people do you realize what the salt is doing, I think it’s a lot of educational stuff. I think that some people who tend to be sort of – they refuse to change, and they see things only one way, but if there’s enough education out there....”
- “I think that’s an educational thing. A lot of people, who aren’t necessarily yet aware of the issues of salt, and the water system, would probably just stop at the first reaction I gave. It takes a little education before, and then most people would say okay, now that you’ve explained it...”

***3) Do you believe that the application of road salt plays a role in water quality? If so, do you believe reducing salt will improve the quality of New Hampshire’s rivers and streams? Is reduced water quality an acceptable trade-off for clear roads?***

Most of the participants did not possess clear opinions about the connections between road salt and water quality, primarily because many of them either did not have enough information about the issue, or did not realize that salt was a contaminant. However, among those who did hold an opinion, the discussions of water quality reflected the split between the participants in the Windham focus groups and the participants in the Concord focus groups. In general, the Windham participants seemed to be more willing to frame road salt contamination as an environmental issue. In fact, several had first hand experience with deteriorating water quality – one participant actually received a new well from the state due to chloride contamination.

Windham participants were also concerned with the condition of nearby Cobbett’s Pond, which is used for recreation and upon which many shoreline homes are situated. Across both Windham focus groups, there was no doubt that road salt and water quality were linked. The Concord participants, on the other hand, tended to frame their perceptions of road salt and water quality in terms of functional and structural issues such as road and bridge conditions, heightened taxes, political opinion, and public safety. Across the two Concord groups, there was no consensus as to whether or not reducing road salt would improve the quality of New Hampshire’s rivers and streams.

When asked if reduced water quality was an acceptable trade-off for clear roads, the Windham/Concord split was again evident. The Windham participants felt that reduced water

quality is unacceptable, whether or not road salt happened to be the main culprit. In fact, these participants saw road salt as only one cause among many that contribute to poor water quality. In contrast, the Concord groups were ready to accept reduced water quality as an unfortunate, but necessary, by-product of clean roads. This perspective tended to be framed as a safety issue, with one participant stating “I’m as much of a tree-hugger as anyone else but public safety comes before the environment.”

As with the application of new technologies, the importance of education about the impacts of road salt was a noticeable strand woven throughout the discussion of water quality. While some focus groups exhibited stronger opinions than others, nearly every participant in the entire project expressed an interest in learning more. The general consensus was that this education should come from state agencies such as NHDES and NHDOT.

Other responses from Focus Group participants included:

- “I don’t think most people are aware that – I never thought about the salt and the environment being related”
- “I’ve lost pine trees, and oak trees, I lost two maples, because of the salt.”
- “I think people who live around here are generally concerned, that’s why I think the education is important.”
- “That should be common knowledge, it should be out so that the papers print so much about this and that, so people have something to say well this is effective, the brewery grains, calcium chloride, more so than straight salt.”
- “To me, anyone who sells the chloride products should be required by law to put together a newsletter that says this is how you can reduce the application of this product, and these are the different sources of information: DOTs, research groups. They should be required by law to distribute that with their product, to whoever’s buying it, whether it’s a municipal DOT, state DOT, or a Wal-Mart.”
- “It all comes down to making people aware of the consequences of what they do. Whether it’s how much power you use, how much gas you use, how much salt is used.”
- “I think education might be an important thing because, you know, I never thought that highway expansion would contribute to pollution – I never made the connection.”
- “I think for this town, for Windham, Cobbets Pond is a big issue. Cobbets Pond is actually going eutrophic, or so they tell us. The water quality is going down the tubes fast. I don’t know the details, but it sounded pretty startling.”
- “I think local conservation commissions could lend a hand in awareness campaigns. Let people know what that is going to do to the water quality. I think if the citizenry were a little more educated, I think we could begin to solve some problems. I don’t think we

should put ourselves in the hands of the state or in the hands of the town fathers because I don't think they know enough about the issue themselves.”

- “It’s never a cut and dried thing to protect the environment. You have to investigate everything that’s occurring and areas that are specifically overloaded.”
- “I think you have to take in the financial situation too. Most of your local communities – one of the largest parts of their budgets is the salt. Depending on the winter, they’ve gone over their salt budget. I’m on the budget committee up in Northfield and that’s one of the biggest issues we have up there.”
- “At the town level, you don’t want to say that you did it to save money. That’s that fear of choosing between money and the environment and public safety. Unless there are studies out there saying that the brine solution is just as safe as the rock salt, they are going to be afraid to do it. They don’t want to be in the lawsuit. They need information from watershed groups, etc.”

#### ***4) Would you be willing to change your driving patterns to allow for the use of less road salt?***

The focus groups were split (again, by location) as to whether or not people would agree to change their driving habits during winter weather. One individual (from a Windham group) stated “I always leave for work one hour earlier when it snows, so why can’t everyone else?” Others, particularly from the Concord groups, expressed reluctance towards making further changes to their already-complicated winter driving routines. Across all four focus groups, participants felt that to some extent, the burden of change should be placed on employers, both public and private, instead of daily drivers. This line of reasoning was based on the idea that employers, such as the state of New Hampshire, should follow the lead of public schools and delay or cancel the workday during inclement weather, thus reducing the number of cars on the road.

The participants in all four focus groups agreed that not everyone is in a position to change their driving patterns during winter weather. As a result, other alternatives were mentioned, including a law requiring all drivers to take a winter weather driving course, eliminating legal liability for the towns and businesses that reduce their application of salt, and the mandatory use of snow tires.

#### **Other responses from Focus Group participants included:**

- “I guess it depends on the employer. Big retail, corporations aren’t going to care. But there are employers in the state, like the State, like UNH, that are a big group that have that ability to say yeah, we’re going to shut down because it’s not worth it to us, or we’ll do the delayed start – give that 2 hour delay so you don’t have to rush to work.”
- “You have to also involve the employers in making the policy and changing.”

- “I often wonder if there should be some sort of regulation to employers, that if it’s really not mandatory, to start later.”
- “I get up early enough as it is – I get up at 4:30 to be to work at 6. You think I want to get up earlier? But I would carpool. I’m all for that.”
- “I carpool, and I think it’s a great idea, and I’ve also gone to work 2.5 hours early when they’ve predicted snow. I would like to see the predictions a little more accurate, because there’s been several times where I’ve bundled up like an Eskimo and there’s just misty rain.”
- “If I feel it’s unsafe to drive, the roads are really bad, then screw work. My life, and my family comes before any job.”
- “I think towns would be more willing to use less salt if they had the information saying that the alternatives were just as safe, and they would protect the environment. And if the public was informed – you know, we’re doing a salt reduction for the first few hours for the storm – if those things were known, then yes that would change my behavior.”
- “I’m from up north, I grew up in Moultonborough and I live in Laconia now, and people are really excited about a snowstorm. I feel like the expectation is ‘Lets Close!’ This is a snowstorm! This is New Hampshire! I really feel like people are celebrating, and not expecting things to be open.”

***5) Do you think reducing the amount of road salt applied or changing the type of material would impact all drivers equally?***

The discussion surrounding this question revealed that the participants see the driving public as organized into three sets of stakeholders, each of whom would be impacted differently by changes to road salt application. First, there are those who have flexible schedules, and can either work from home (telecommute) or alter their work hours. These individuals possess the capacity to stay off the road during winter weather, and usually do. The second group involves those who have no flexibility in either their work hours or the location at which they perform their work. This group, including nurses, hourly workers, state employees, and teachers, would be the most impacted by changes to salt-application processes. The third and final set of stakeholders are out-of-state drivers who, in the opinion of many of the participants, would be unable to appropriately navigate winter road conditions no matter what the road salt policy.

The focus group participants did acknowledge that any potential change to road salt policy in New Hampshire could privilege one set of stakeholders over another. For instance, a policy simply reducing the amount of salt would disadvantage those who do not have the option of staying off winter roads. This provided further evidence for the participant’s assertion that businesses and employers should bear the burden of change, instead of the driving public. Put simply, if hourly employers were to become more flexible about attendance during hazardous conditions, fewer cars would be on the road.

As with the other focus group findings, the participants in Windham for the most part enjoyed more flexibility than their Concord counterparts. Many of the Windham participants had shorter commutes, and several of them described having the ability to work at home. The Concord participants, on the other hand, tended to engage in longer commutes, and very few were able to take advantage of telecommuting arrangements.

Other responses from Focus Group participants included:

- “Why can’t they just make a drastic change, and see what happens. With the climate change, too, the winters have changed so much in New Hampshire, it’s really drastic. Why can’t we say Yes! We’re using way less salt – do a public campaign and tell people its their responsibility to drive carefully.”
- “Out-of-staters are not going to know what’s going on? You come up for skiing. Unless they have something that says the State of New Hampshire is a low salt state, just so they’ll be aware. There’s always a certain percentage of people who won’t change – they want to get there.”
- “I think people usually have adaptations they can make, it’s just that its not the first thing they think about. They’ll say well geez, I work in Boston and I have to be there every morning at 8, or whatever it is, so what have I got to do? They answer is well there are some things you can do, like leaving earlier, and so forth. It’s not fun, but most folks have choices they can make, somehow.”
- “The state is just hell bent on this highway expansion. They just don’t want to think outside of the box. They have excuses. They’re not thinking about the possibility of change. If the transit system improved, and matched the new train schedule, people would be willing to try it.”
- “They need to hear that the options are just as safe, and it’s not going to cost them as much. Or it’s going to cost them a little more but its okay. A lot of people don’t live here because they love the environment. They’re here because of their job, they’re here because of their family, they are here because of other things. Or, they may love the state and they may love the water, but they are not willing to risk their safety for it. I love the environment, but I’m not willing to risk my safety for it. I would pay a buck extra in my taxes or something, but I’m not willing to say well its one or the other. I think most people wouldn’t be willing to say that. You don’t want it to be a choice, because the environment won’t win.”

**Focus Group Conclusions**

Clearly, no one who participated in the four focus groups wanted to reward long-distance commuters or out-of-state tourists at the expense of New Hampshire’s watersheds. However, the

driving public clearly does not share one single perspective regarding either the current condition of roads in the winter, the application of road salt or its alternatives, or the environmental conditions that result from the application of road salt. The variables that act in this equation included a participant's locality, their occupation, and the length of their daily commute.

Despite these complicating factors, the single most dominant message emerging from the focus groups is that the driving public is willing to receive education (from the State) regarding the environmental impacts of road salt. Using that information, they *may* be willing to change their driving habits accordingly. How the information is received and whether or not habits are changed will depend on the variables mentioned above. Therefore, any education or information must be provided in multiple ways, designed specifically for different audiences. For some, the issue should be framed in terms of the environment, while for others, it should be presented using the local languages of taxes, expenses, and safety.

The focus group participants were enthusiastic, interested in the topic, and prepared. Their different perspectives were informed by the diversity of their economic, social, and political backgrounds. Therefore, the education that they described as missing from their understanding of the road salt issue was often visualized and described in different ways. For example, the participants that saw road salt as an environmental issue (such as many of the Windham participants) wanted education for the purpose of influencing lawmakers and swaying public opinion. On the other hand, the participants that concentrated on the more structural and functional issues surrounding their day-to-day lives (such as many of the Concord participants) wanted education for the sole purpose of allowing business owners, state agencies, schools, and drivers *to make driving choices themselves*. By far, participants favored education over other options such as new technology, or different methods of salt application.

The focus group participants felt that any education regarding the environmental impacts of road salt should come from NHDES and NHDOT. Furthermore, it should be aimed at not only the three sets of stakeholders within the driving public, but the business/employment community as well. Finally, it should include information for those who are not yet able to drive, as they make up New Hampshire's next generation of drivers. As one participant stated, "thinking about the future, those children that are in school right now, they are leaders of the future. Wouldn't it be good to get them to start thinking about what the world is going to be like when they're old enough to be making decisions?"

### Potential Solutions Identified by the Focus Groups:

- Use education initiatives on road salt and its impacts on water quality, directed at the driving public, to change driver habits;
- Educational and informational efforts should be presented by NHDOT and NHDES in multiple ways and designed for different audiences;
- Provide additional enforcement to reduce speed limits during storm events;
- Use technology (cameras, radar, and other devices) to assist with enforcement;
- Create “No Salt” areas;
- Create additional public transportation alternatives;
- Engage employers and delay or cancel work related activities during inclement weather;
- Pass a law requiring all drivers to take a winter weather driving course;
- Eliminate the legal liability for towns and businesses that reduce their application of salt; and
- Require mandatory use of snow tires on New Hampshire roadways.

## VIII. Conclusion

The use of road salt for the treatment of roadways and parking surfaces has led to numerous environmental impacts and a reduction in road salt use is necessary, both because of the environmental degradation and to ensure water quality standards for chlorides will be met so that the expansion of I-93 in New Hampshire can be permitted. If the communities in southern New Hampshire continue to grow and see land use changes it will also be extremely important that future development or redevelopment efforts do not require an overall increase in the use of road salt. A variety of techniques will need to be employed at the local level to ensure that new development does not contribute to this salt loading problem. Fortunately, many of these techniques also meet the objectives of Smart Growth and sustainability initiatives that New Hampshire communities are also beginning to orient their community plans and regulations toward.

The various research methods summarized in this second report to the I-93 Salt Reduction Workgroup reveal the need for a comprehensive approach to the issue of road salt reduction on existing surfaces. As we look for ways of reducing the usage of road salt on roadways and parking lots it is clear that the issue of salt loading is complex and has no single solution. The search for possible solutions becomes even more complex as we consider the variety of surfaces being treated in each of the Watersheds, the varying winter weather conditions, and future development pressures. Several possible solutions were identified by multiple research methods:

- Training on treatment practices for maintenance professionals (public and private);
- Equipment and infrastructure upgrades;
- Behavior change programs to assist with voluntary and mandatory approaches;
- Lower speed limit during storm events; and
- Mandatory use of snow tires for the public

A blend of approaches will need to be used if any reduction of road salt use is to be achieved, and there must be a commitment to this reduction at all levels by a full range of stakeholders. There is a role for the State of New Hampshire, the municipalities, private property owners, winter maintenance professionals, and the driving public. The research completed by Plymouth State University revealed that the private sector surfaces in the Watersheds being studied accounted for fifty-seven percent (57%) of the total surface area being treated during winter maintenance activities. This may be the toughest sector to achieve reductions in as this effort moves forward. One area that needs further investigation is the question of liability related to the treatment of private parking lots. The matter of who is ultimately liable in the case of an accident, and what recommended treatment protocol is being followed needs to be addressed. Limiting the liability for private property owners and private contractors that are using recommended treatment practices is worthy of further investigation.

The combination of training, equipment and infrastructure upgrades, behavior change programs, legislation, local design standards and other initiatives will enable a cooperative salt reduction effort involving all stakeholders. This cooperative effort will also require political support, some initial funding, and changes in behavior and expectations related to winter weather events.