



# Training for Winter Maintenance Supervisors and Operators

Center for Transportation Studies  
University of Minnesota



**CLEAR ROADS**

research for winter highway maintenance

**Project 99008/CR12-04**  
**February 2017**

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<b>16. Abstract (Limit: 250 words)</b> Researchers created 22 modules for use in teaching maintenance workers and their supervisors on a variety of topics relating to roadway snow and ice control. The project was funded through the Clear Roads program, and was initiated because every state has some training for snowplow operators and supervisors, but each training program has both strong and weak aspects. The objective was to develop a training program for use by all member agencies that provides the flexibility for each state to modify or update the training modules as needed. To accomplish that, they developed a list of 22 priority modules, as well as a comprehensive list of materials and resources to use in their development. Researchers developed a teaching guide, summary, and pre- and post-test documents for each. The teaching guide clearly outlines how to deliver each module, with recommendations for discussion and additional resources, such as videos and published materials. Snow and ice control topics include plowing, truck operations, spreading, materials use, prewetting, brine production, deicing, anti-icing, level of service, ice formation, freeze point depressants, environmental issues, drift control, weather, avalanche management, bridge frost, safety, and driver education. This final report describes the researchers' work process; for access to the training materials, please contact Greg Waidley at <a href="mailto:greg.waidley@ctcandassociates.com">greg.waidley@ctcandassociates.com</a> .		<b>13. Type of Report and Period Covered</b> Final report [September 2014 to April 2017]	
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# Training for Winter Maintenance Supervisors and Operators

## FINAL REPORT

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## **Final Report and Recommendations**

As part of this project, the University of Minnesota Center for Transportation Studies (CTS) created 22 modules for use in teaching maintenance workers and their supervisors on a variety of topics relating to roadway snow and ice control. The project was funded through the Clear Roads program, an ongoing pooled fund research project aimed at rigorous testing of winter maintenance materials, equipment and methods for use by highway maintenance crews.

The project was initiated because every state has some training for snowplow operators and supervisors, but each training program has both strong and weak aspects. Clear Roads wanted to develop a training program for use by all member agencies that provides the flexibility for each state to modify or update the training modules as needed. To accomplish that, they developed a list of 22 priority modules, as well as a comprehensive list of materials and resources to use in their development. Jim Grothaus from CTS served as the principal investigator and local project manager. Connie Fortin of Fortin Consulting was the primary developer of the teaching modules, which were created in Power Point format. Fortin Consulting staff also participated in module review and formatting. CTS staff developed a teaching guide, summary, and pre- and post-test documents for each. The teaching guide clearly outlines how to deliver each module, with recommendations for discussion and additional resources, such as videos and published materials. This final report describes the researchers' work process; for access to the training materials, please contact Greg Waidley at [greg.waidley@ctcandassociates.com](mailto:greg.waidley@ctcandassociates.com).

### **Process Narrative**

This project was awarded to the Center for Transportation Studies (CTS) at the University of Minnesota<sup>1</sup> on August 14, 2014. The research team consisted of Jim Grothaus, Principal Investigator; Ann Johnson, Project Coordinator; and Connie Fortin, Technical Writer and Content Developer. Clear Roads had already established a Technical Advisory Committee that consisted of the representatives listed in Table 1.

The first three months were spent identifying topics to be included, and then identifying and prioritizing the content. In December, the TAC identified the 18 primary modules, and a key TAC members was assigned to each of them. Those key members are identified in Table 2 below.

Although the TAC agreed on the 18 primary modules identified below, several additional important topics were identified early in the process. The TAC prioritized the first 18 modules, and agreed to revisit those topics identified below later. Some of these topics were incorporated into other relevant modules, as listed in Table 3.

**Table 1. Technical Advisory Committee Representatives**  
(accurate at the time of contract execution)

<b>Name</b>	<b>Agency</b>
David Wieder (Chair)	Colorado DOT
Justin Droste (Vice Chair)	Michigan DOT
W. Clay Adams	Kansas DOT
Joseph Baker	Rhode Island DOT
Craig Bargfrede	Iowa DOT
Lynn Bernhard	Utah DOT
Brian Burne	Maine DOT
Patty Caswell	Oregon DOT
Tim Chojnacki	Missouri DOT
John S. DeCastro	Connecticut DOT
Caleb B. Dobbins	New Hampshire DOT
David Frame	California DOT
Wayne Gammell	Vermont DOT
Larry Gangl	North Dakota DOT
Jason Humphrey	South Dakota DOT
Justun Juelfs	Montana DOT
Mike Lashmet	New York DOT
Scott Lucas	Ohio DOT
Monty Mills	Washington DOT
Tim Peters	Illinois DOT
Tom Peters	Minnesota DOT
Tom Renninger	Nebraska
Richard Roman	Pennsylvania DOT
Sam Salfity	Massachusetts DOT
Cliff Spoonemore	Wyoming DOT
Mike Sproul	Wisconsin DOT
Kyle Stollings	West Virginia DOT
Allen Williams	Virginia DOT
Ron Wright	Idaho DOT

**Table 2. Clear Roads TAC Representatives for each Module**

<b>Module</b>	<b>Description</b>	<b>TAC Representative</b>
1	Plowing Procedures	Mike Lashmet
2	Truck Operations	Mike Lashmet
3	Spreaders	Mike Lashmet
4	Material Use	Mike Lashmet
5	Pre-wetting	Mike Lashmet
6	Brine Production	Clay Adams
7	Deicing	Monty Mills
8	Anti-icing	Clay Adams
9	Safety	Clay Adams
10	De-Icing Agent Management Policy	Dave Wieder
11	LOS	Justun Juelfs
12	Principles of Ice Formation	Cliff Spoonemore
13	Science of Freeze Point Depressants	Monty Mills
14	Snow and Ice Control Agents and the Environment	Monty Mills
15	Drift Control	Cliff Spoonemore
16	Weather Basics	Mike Sproul
17	Bridge Frost	Mike Sproul
18	Avalanche Management	David Wieder

**Table 3. Additional Important Snow Removal Topics**

<b>Topic</b>	<b>TAC Representative</b>
Maintenance Yards	Justun Juelfs
Snow Disposal	Clay Adams
Managing Snow Disposal Sites	Clay Adams
Record Keeping	Monty Mills
Wind	Cliff Spoonemore
Weather Tracking & RWIS	Mike Sproul
Weather and Decision Making	Mike Sproul
MDSS	Mike Sproul
Assistance to Motorists	Clay Adams
Supervisors and Winter Maintenance	Dave Wieder
Tips from Experienced Drivers	Monty Mills

Work began on developing content for the first set of modules soon after the priority list was developed. As required by Task 1, CTS proposed a content development process, as outlined below.

After the first 18 modules were developed, the Technical Advisory Committee identified 6 additional modules to develop. Those 6 modules are listed below in Table 4.

### **Content Development Process**

1. Review the “Reference Materials: Training for Supervisors and Operators” which correspond the module under development. This list is posted on the Clear Roads website. These are all items that the advisory TAC have specifically deemed appropriate and valuable for the national training modules.
2. For items in the “Reference Materials: Training for Supervisors and Operators” if items are found that are in PDF form, request them in a different form for use in the training module.
3. Review AASHTO’s Computer Based Training modules. In each Clear Roads module cross reference any sections of these modules that might be useful to the audience. Cross reference will include the disk/module name and the appropriate section in the training disk/module
4. Review other Clear Roads research to include or link to as needed in a module.
5. For additional technical information to fill in gaps from the above resources:
  - Consult with Woody Woodruff and Norm Ashfeld (retired MnDOT), the contract technical experts on this project.
  - Consult with Michael Sproul (WIDOT) lead person for this project
  - Consult with the Module chairperson as listed on “Winter Maintenance Operator and Supervisor Training Modules – Class Matrix”
  - Consult with other Clear Road Advisors that have expertise in the module area
  - Draw from FCI, CTS expertise, photographs, experience in these areas
  - Conduct internet searches
  - Conduct phone or email interviews from other experts in this area

Once content was identified, CTS developed the power point presentations and teaching notes. The process is outlined as follows:

1. As individual module content is developed, CTS distributes it to the TAC for review.
2. Members of the TAC review module content and format, and summarize their comments in an email to CTS.
3. CTS reviews the comments, and summarizes all remarks into one document for each module.



4. Review comments are incorporated into the modules, and changes made as agreed to by the TAC and primary TAC representative. When conflicts arise, CTS summarizes them and a conference call is scheduled to agree on content moving forward.
5. Final edited modules are distributed to the TAC members, and final comments are obtained.
6. CTS incorporates final review comments into the modules.

Once the final content for the presentations was agreed to by the TAC members, CTS developed an Instructor's Guide for each of the modules. This guide includes the following information for each module:

- Content summary
- Learning objectives
- Format and instruction on how to use the power point and teaching notes
- A summary of each slide, along with teaching and discussion notes for each
- Resources to bring to class for outlining requirements for your specific agency
- Suggested activities such as the pre- or post-test
- Additional resources that might enhance the presentation

Also, CTS developed a pre- and post-test, along with answers for all questions in word format for each module. In addition, CTS developed a participant evaluation for use by presenters.

All content for each of the original 18 modules, including the Instructor Guide, pre- and post-tests and participant evaluations were posted on a shared file server for review by the TAC by August of 2016.

In June of 2016, the TAC met to discuss additional needs for this project. An amendment has been processed to develop more training modules. Those modules are listed in Table 4 below.

**Table 4. Supplementary Modules Included in Amendment 1**

<b>Module</b>	<b>Topic</b>	<b>TAC Representative</b>	<b>Description</b>
19	Supervisors and Winter Maintenance	Wayne Gammell	Audience: winter maintenance supervisors. Objective: to provide a broad insight with regards to establishing LOS goals, resources required to meet those goals and understanding of the staff development needs to achieve sustainability.
20	Record Keeping	Randy Geaumont	Objective: to convey the importance of accurate record keeping and how it can help you make better decisions in your snow and ice program. Information is presented about how informed decision-making can happen before, during and after winter storms and winter seasons.
21	Assistance to motorists	Clay Adams	Note that this may include a state-specific policy and may not fit into a stand-alone module.
22	Snow Disposal and Managing Snow Disposal	None	Objective: to explain what to do with the snow that must be loaded into trucks and hauled to a storage site.
23	Getting Ready for Winter	Scott Lucas	Objective: to inform about the preparation for winter operations. Topics will include: <ul style="list-style-type: none"> <li>• Manager and operator training</li> <li>• Facility inspection and repair</li> <li>• Stocking of deicers and abrasives</li> <li>• Equipment inspection and repair</li> <li>• Winter snow plow route review</li> <li>• Meeting with emergency services and neighboring local public agencies</li> </ul>
24	Driver's Education	Cliff Spoonemore	Objective: to provide driver's education training for high schools, driver education schools, and the public. Topics can be broken into 3 categories: preparation for, during, and after the trip.

Note: Modules 21 and 22 were cancelled by the Clear Roads TAC, and not completed.

## Module Descriptions, Target Audience, Key Topics and Estimated Time to Deliver

As noted above, the first phase of this project included the development of 18 primary modules, followed by 4 supplementary modules. They are listed below in Table 5, along with key topics, the target audience for each, and the estimated time to deliver each module. Note that the instructor guide for each module contains additional information about how to teach each module, and suggests discussion topics for each slide.

**Table 5. Clear Roads Primary Modules**

Module	Topic	Key Topics	Target Audience	Estimated Time
1	Plowing Procedures	This module includes guidance for one-person and two person plowing operations, and how to operate with various plow configurations (nose plow, reversible and one-way, right wing only, left wing only, double wing, underbelly plows). Information on Echelon/gang plowing and tandem plowing techniques and strategies is provided, as well as recommendations for plow speeds, actions for whiteout conditions, and plowing tips from experienced drivers.	All level of plow drivers and supervisors	180 minutes
2	Truck Operations	The truck operations module includes information about operator and supervisor responsibilities for pre- and post-op checks of trucks, how to clean trucks after storm events, guidelines for the maximum operation duration for trucks, and operator certifications for plow configurations (single and double wing plows.)	All level of plow drivers and supervisors	90 minutes
3	Spreader Procedures	Different types of spreaders and spread controllers are discussed in this module, along with how to calibrate spreader units. This module also provides information on spin speeds, patterns to reduce bounce and scatter, and how to use saddle tanks and slurry units.	All level of plow drivers and supervisors	120 minutes
4	Material Use	This module describes how to identify common, cost-effective snow and ice control materials; how to use the right amount of material at the right time; and strategies to minimize material use.	All level of plow drivers and supervisors	120 minutes

5	Pre-wetting	In this module, the benefits to pre-wetting materials that improve cold weather performance, reduce bounce, and scatter are outlined, along with strategies to reduce material use. Methods of pre-wetting (e.g. on-board spray units, pug mill mixing on site, delivered pre-wet) are described, as well as the use of saddle tanks for on-board pre-wetting systems.	All level of plow drivers and supervisors	120 minutes
6	Brine Production	This Clear Roads training module provides information about the basics of brine making and considerations for determining if brine production should be part of your agency's maintenance activities.	All level of plow drivers and supervisors	90 minutes
7	De-icing	Pro-active de-icing and reactive anti-icing strategies are covered in module 7, along with information about application rates, conditions for de-icing, and using liquids in de-icing operations.	All level of plow drivers and supervisors	120 minutes
8	Anti-icing	This module outlines the advantages of anti-icing vs. deicing, materials that can be used for anti-icing, anti-icing equipment, and when and where to apply anti-ice materials	All level of plow drivers and supervisors	90 minutes
9	Safety	This module contains information about safety, including issues that require special consideration to operate safely during the winter and the hazards of snow and ice control, including slippery surfaces, cold weather, poor visibility (both in the yard and out on the highway), working at night, and working long hours.	All level of plow drivers and supervisors	120 minutes
10	De-Icing Agent Management Policy	This module includes information on the storage of liquid and granular products, quality Assurance of both granular and liquid delivered materials, good housekeeping practices, and storage inspection.	All level of plow drivers and supervisors	90 minutes

11	Level of Service	The Level of Service module can be used to inform staff of the most common factors considered when determining acceptable level of service. It also includes level of service guidelines from several states DOTs with ranging Annual Average Daily Traffic (AADT) and the benefits of managing areas based on need, regain time and available resources.	All level of plow drivers and supervisors	90 minutes
12	Principles of Ice Formation	The ways that ice is formed are included in this module, including traffic compaction, snow-packed ice, black ice, snow glaze, blow ice, and freezing rain.	All level of plow drivers and supervisors	120 minutes
13	Science of Freeze Point Depressants	This module describes freeze point depressants and how they work. It also gives a description of chemical slipperiness and how it applies to snow and ice control, as well as endothermic and exothermic processes. It describes chemical eutectic and effective temperatures, phase diagrams, and factors which influence effectiveness of freeze point depressants.	All level of plow drivers and supervisors	90 minutes
14	Snow and Ice Control Agents and the Environment	This module focuses on the impacts of chlorides, organics, and abrasives on the environment.	All level of plow drivers and supervisors	120 minutes
15	Drift Control	Module 15 describes the effects of wind on snow, and describes drift control best practices. It also outlines the selection of drift control recommended practices, and provides several drift control case studies.	All level of plow drivers and supervisors	150 minutes
16	Weather Basics	Weather forecasts, tracking, and decision making are covered in this module, in addition to Road Weather Information Systems (RWIS) and Maintenance Decision Support Systems (MDSS).	All level of plow drivers and supervisors	250 minutes
17	Bridge Frost	How bridge frost and black ice develop is one of the topics in this module, along with information about how to use weather forecasts to know when bridge frost is possible. When to anti-ice in anticipation of bridge frost and how to anti-ice or treat bridges is also included.	Entry-level or experienced plow drivers and supervisors	90 minutes

18	Avalanche Management	This module describes avalanche conditions, how avalanches form, the most likely times for avalanche occurrences, and avalanche hazard reduction methods for maintenance staff.	Entry-level or experienced plow drivers and supervisors	120 minutes
19				
20				
21				
22				

### Trial Delivery and Evaluations

CTS staff presented the first four modules at the Minnesota Fall Maintenance Expo, a workshop attended by hundreds of maintenance workers from all over the state. Each session was summarized and presented by Kathy Schaefer, a MnDOT employee and Circuit Trainer Assistance Program instructor. The sessions were 45 minutes each, and at each session, attendees were asked to evaluate the module content and its relevance to attendee’s jobs. A summary of each session’s evaluations is given below. Note that participants were asked to rate the sessions on a scale of 1-5, with 1 being “least effective” and 5 being “most effective”.

At each of the 4 pilot training sessions, participants noted that their understanding of each topic increased from attending the 45-minute session. We were also able to gather data on which portion of the training was the most valuable to participants. And, in each of the 4 session, nearly 100% of survey respondents would recommend these presentations to their colleagues.

### Module 1 – Plowing Procedures

Attendees: 79      Evaluations: 64

Criteria	Average Score (on a scale of 1-5)
The presentation covered the promised objectives.	4.36
The presentation was interesting and well organized.	4.34
I received skills and knowledge that I can apply to my job.	4.41
How would you rate your understanding of material use before today?	3.89
How would you rate your understanding of material use after today?	4.36
<b>Topics found to be most needed by audience</b>	<b>Number of times mentioned</b>
1-person plowing techniques	32
Plow configurations	22

Plowing speeds	22
Spreading speeds	18
Plowing in a whiteout	18
Tandem plowing techniques	14

## Module 2 – Truck Operations

Attendees: 68      Evaluations: 47

Criteria	Average Score
The presentation covered the promised objectives.	4.43
The presentation was interesting and well organized.	4.43
I received skills and knowledge that I can apply to my job.	4.32
How would you rate your understanding of material use before today?	4.26
How would you rate your understanding of material use after today?	4.51
Topics found to be most needed by audience	Number of times mentioned
Operator and supervisor responsibilities for pre- and post-op checks of trucks	28
Cleaning trucks after storm events	26
Operator certification for plow configurations	12
Requirements for maximum duration of operation	10

## Module 3 – Spreaders

Attendees: 17      Evaluations: 21

Criteria	Average Score
The presentation covered the promised objectives.	4.48
The presentation was interesting and well organized.	4.48
I received skills and knowledge that I can apply to my job.	4.52
How would you rate your understanding of material use before today?	4.33
How would you rate your understanding of material use after today?	4.57
Topics found to be most needed by audience	Number of times mentioned
Spreader speeds	13
Delivery systems	11
Calibration	10
Spreaders	6

## Module 4 – Material Use

Attendees: 45

Evaluations: 29

<b>Criteria</b>	<b>Average Score</b>
The presentation covered the promised objectives.	4.59
The presentation was interesting and well organized.	4.45
I received skills and knowledge that I can apply to my job.	4.45
How would you rate your understanding of material use before today?	4.24
How would you rate your understanding of material use after today?	4.52
<b>Topics found to be most needed by audience</b>	<b>Number of times mentioned</b>
Temperature impacts	16
Salt use	14
Application rates	11
Cost-effective materials	9
Sand use	9
When to use dry vs. liquid product	8
Blends	8
Common materials	7
Application Rates	11

### Recommendations

Each of the 22 modules created as part of this project contain a power point presentation with embedded teaching notes; an instructor guide that includes directions for their use, notes, additional resources, and suggested activities; and a set of participant tests and evaluations to use if needed.

The modules will be posted and easily available to the Clear Roads member states. The modules will also be available to the greater winter maintenance community if they contact the Clear Roads Administrator to request access. This material is current as of April 2017, but it may become out of date, and a process for review is needed. Also, gathering the data about who is using each module, how they are using it, and the evaluations they receive is important in assessing the value of this project.

For that purpose, we recommend that Clear Roads designate one member of the project TAC to review the content for one module annually, and make any changes to the presentations, instructor guide, and tests. We also recommend that the Clear Roads designee for each module review the evaluations that are received upon completion and use. We also recommend that



Clear Roads budget funds for the research team to continue to integrate comments, changes, and feedback into each of the modules after a short trial period in which member states are encouraged to use the modules.

Other recommendations include:

1. Developing a specific and formal review process that tracks comments and feedback from the TAC, and provides documentation for how issues and questions are resolved by the TAC and report author.
2. Developing an efficient method for sharing large files between the author, Principal Investigator, and TAC.
3. Clear Roads conduct an annual review of materials for clarity and accuracy, and to confirm that links and resources are still available and active.
4. Clear Roads create a marketing strategy or document each year for publicizing the available products to Clear Roads member states. We recommend this happen in July or August of each year.
5. Clear Roads work with Local Technical Assistance Programs to publicize this series of modules, and to assist with training.
6. Clear Roads conduct an annual training webinar for Clear Roads members to discuss this product and others as they are completed.



research for winter highway maintenance

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