

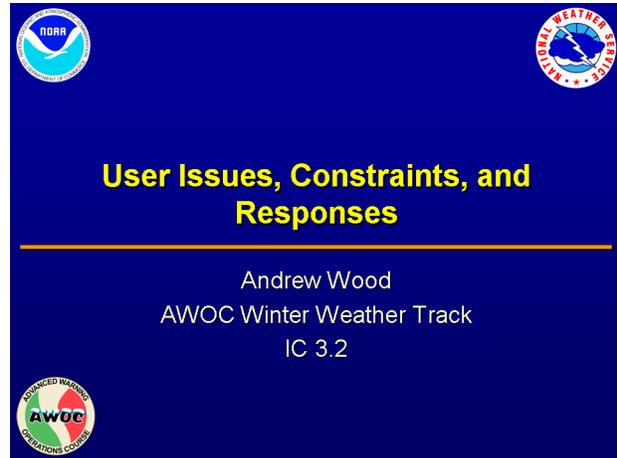
---

---

# 1. IC3.2: User Issues, Constraints, and Responses

**Instructor Notes:** Welcome to the AWOC Winter Track Instructional Component 3, Lesson 2. This presentation, entitled User Issues, Constraints, and Responses, should last approximately 20 minutes. A common theme that will be touched on often during this lesson is the importance of knowing what your local users need or do to mitigate a winter weather event's impacts.

**Student Notes:**



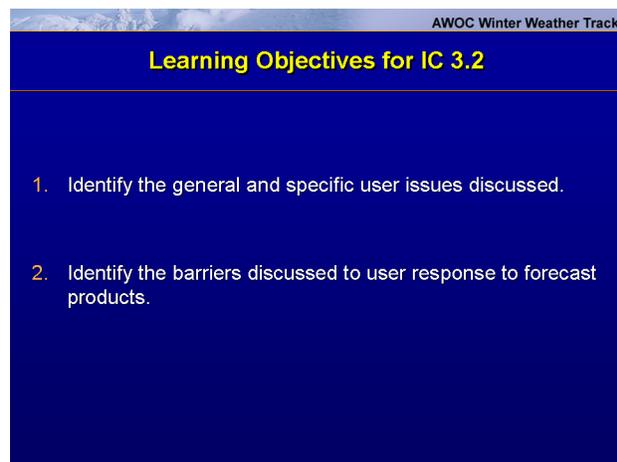
---

---

## 2. Learning Objectives for IC 3, Lesson 2

**Instructor Notes:** There are two objectives with this lesson. The first objective is, by the end of the lesson, you should be able to identify the user issues discussed that affect the general population and specific user groups. The second objective is to identify the barriers to user response of forecast products discussed in this lesson.

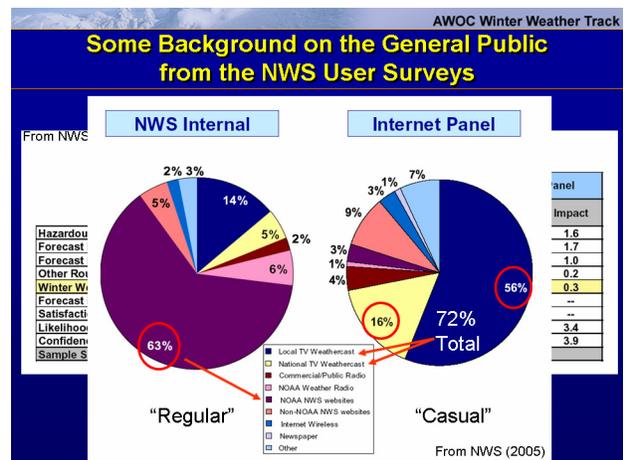
**Student Notes:**



### 3. Some Background on the General Public from the NWS User Surveys

**Instructor Notes:** Across the board, winter weather products and services were rated high by NWS users (NWS, 2005). The general public portion of the user survey was noteworthy because it was made up of two different groups of people. The first group regularly obtain weather information directly from the NWS web site, while the other group better reflect the nation as a whole who primarily get their weather information from TV and only casually access NWS web sites, if at all. The “regular” user group was most likely to obtain weather information from the NWS primarily for personal safety and property protection, work activities, or transportation decisions. The “casual” user group was as likely to obtain weather information primarily to select what to wear on a given day as they were for all of the other categories previously mentioned combined. With these differences in mind, these groups had two significant traits in common. Both groups rated highly accuracy and sufficient lead time for NWS winter weather watch and warning products. They also listed transportation as a primary reason for obtaining weather information in similar levels of importance (26% and 18%, respectively).

**Student Notes:**



### 4. Some General User Issues with Regards to Winter Weather Information

**Instructor Notes:** One thing that was clear from the NWS user surveys is that one size does not fit all. However, there are a few generalizations that can be made. In the previous lesson, we mentioned that many users can get overwhelmed with weather information that they don't need. While they may get extensive weather information about an impending event, most users are left wanting for more pertinent weather information. For instance, many users want more information during an event on snow totals and intensities. Others want more detailed info in short-term forecasts. A lot of times it's not more information they want, but clearer information. A common example users stated was wanting to see watch, warning, and advisory (WWA) products that are more cohesive



## 6. Some Background Information on Road Maintenance

**Instructor Notes:** Let's start with a quick primer on road maintenance. Road crews generally have two significant time frames where they need weather information. The first timeframe is the 12-48 hours prior to an event where they will do most of their strategic planning. The other timeframe is in the 12 hours (especially the last three hours) leading up to the event where they do most of their tactical planning. Examples of activities that occur during each timeframe are available on the slide. How roads are treated will depend on their levels-of-service (LOS). Many major roadways with high traffic volume often require bare pavement LOS. Rural roads will generally have higher thresholds (3" or more), with secondary roads usually somewhere in the middle. In areas where snow is less common, and snow removal resources are limited, LOS classification may focus solely on roads that are designated as "snow routes" and leave other roadways untreated until after precipitation has ceased (if they are treated at all) because of equipment or budgetary limitations.

**Student Notes:**

AWOC Winter Weather Track

### Some Background Information on Road Maintenance

From Federal Highway Association



High Threshold

Low Threshold

**Examples of Differences in Levels-of-Service (LOS)**

Strategic
Prepare Work Schedules
Prepare Vehicles
Ensure Necessary Supplies Available

Tactical
Equip Vehicles
Schedule Specific Routes
Go/No Go

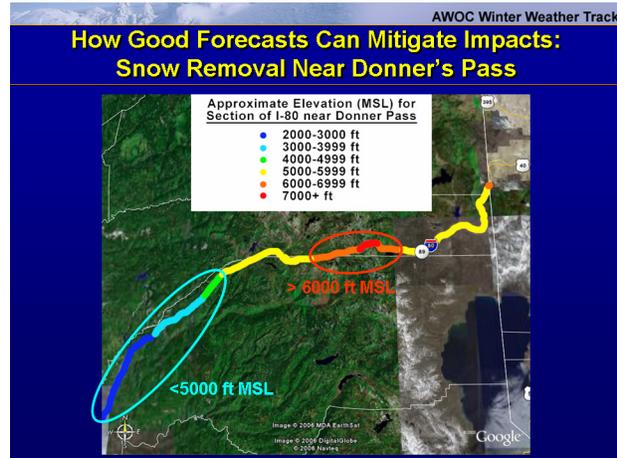
- Strategic: 12-48 hrs prior to event
- Tactical: 0-12 hrs prior to event
- Levels-of-Service (LOS) impacts

## 7. How Good Forecasts Can Mitigate Impacts: Snow Removal Near Donner's Pass

**Instructor Notes:** Every year, over \$2 Billion across the US is spent on snow and ice removal (FHWA and Aurora, 2005), including stocking of material, purchasing equipment, and scheduling crews. If resources are used to mitigate an event that is either overforecast or a total false alarm, then those resources would be depleted unnecessarily. If a forecast of a single large snow does not pan out, it can consume most, if not all, of a small organizations snow removal budget for a winter season in some areas. If crews are not prepared for an event (due to a poor or miscommunicated forecast, etc.), snow removal may cost more due to the need to hire extra contractors (at greater costs) or due to use of more chemicals and equipment for longer periods of time. In some cases, small variations in an event can lead to substantially higher or lower costs. An example is the

costs for road crews in the vicinity of Donner Pass in the Sierra Nevada, which vary depending on the snow level. The largest section of I-80 in this region is located between 5,000 and 6,000 ft. MSL. An accurate forecast of the snow level being at or above 6,000 ft. (vs. at or below 5,000 ft.) can save CDOT approximately \$50,000 per event (Carter et al., 2003). Those dollars add up quickly when you average over a hundred inches/yr. of snow over numerous events.

**Student Notes:**



## 8. Typical Substances Used for Road Treatment Applications

**Instructor Notes:** Roads can be treated many ways: with road treatment chemicals (such as salt) that lower the freezing point of water, by plowing, with sand for improving traction, or combinations of each. Road crews also have the option to pretreat (often referred to anti-icing) or treat during the event (also called de-icing). The substances used to treat roads depends on a variety of factors including costs, weather conditions, and treatment strategy. Different salts (like NaCl, CaCl, and MaCl) are used when road temperatures are lower. NaCl is the most commonly used treatment mostly because it is the cheapest. However, it and other salts can be environmentally damaging. Generally, road salts are used in just enough quantities to keep snow, or slush, from turning to ice. Acetates (like CMA and KAc), which are more environmentally friendly, are being used more frequently on highways and other major roads where the goal is to keep the roads snow free. They are more expensive than other treatments and are generally only effective while road temperatures are 23 F or higher. A third option is to use sand, which is often mixed with salt treatments at colder temperatures (especially below 10 F) to help with traction. (Transportation Research Board, 1991)

Student Notes:

AWOC Winter Weather Track

### Typical Substances Used for Road Treatment Applications



Salts	Acetates
NaCl	CMA
MgCl	KAc
CaCl	

- Salts (more de-icing than anti-icing)
- Acetates (usually anti-icing, occasional de-icing)
- Sands (de-icing)

## 9. More Information on Road Treatments

**Instructor Notes:** Acetates are generally used as anti-icing treatments, meaning they are applied as a liquid well prior to an event (and allowed to dry on roads) in hopes of preventing ice formation. This pretreatment can also be helpful in areas where snow is not plowed right away, as the snow will generally insulate the ground and keep it from getting below 23 F (if it was originally warmer than that). For de-icing, salts are used more often. They are applied shortly before an event begins or after it has started to melt snow and ice.

Student Notes:

AWOC Winter Weather Track

### More Information on Road Treatments

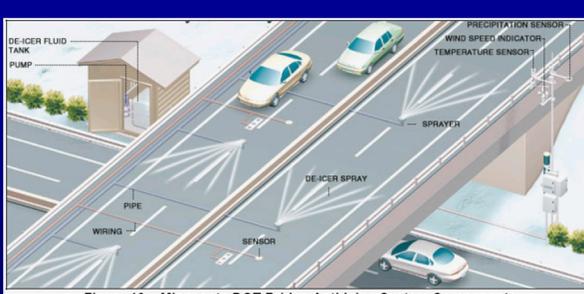


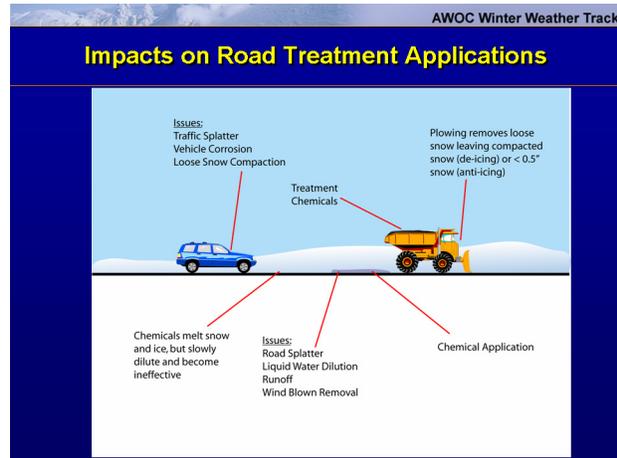
Figure 10 – Minnesota DOT Bridge Anti-icing System Components  
From Federal Highway Administration, "Best Practice for Road Weather Management"

## 10. Impacts on Road Treatment Applications

**Instructor Notes:** Many things can impact road treatment applications. For instance, road traffic can cause treatments to splatter off the road, having a detrimental impact. In high enough volumes, however, traffic may help melt frozen precipitation. More (or less) liquid equivalent precipitation, especially if precipitation starts as rain, can dilute treatment more than intended. Strong winds can also blow solid treatment off roads and significant temperature changes can render certain treatment strategies ineffective.

(Hallowell and Blaisdell, 2003) Mechanical equipment is more impacted by snow density. Wetter, or higher liquid equivalent, snow takes more of a toll on snow removal equipment, which most local governments keep in service past their life expectancy, than dryer snow (Call, 2005). If there have been a series of wetter snowfalls recently, there may be a higher percentage of equipment problems during an event.

**Student Notes:**



## 11. Sector Specific Issues: Municipalities and Road Maintenance

**Instructor Notes:** Having discussed road maintenance in some detail, let's move onto some of the specific issues municipalities and road crews face during winter weather events. While they need weather information during both strategic and tactical time frames, more detail is needed during the tactical time frame. Even if they only get 2-3 hours lead time on specifics, say where the rain-snow line will be or a heavier mesoscale snowband will set up, a plan of attack can often be developed based upon their strategic planning. They could also use good real-time information on precipitation rate and total accumulations (Mahoney, 2003). If an event is evolving in a manner different than forecast, even in small or subtle ways, it can have a huge impact on their operations. Road temperature is obviously critical to treatment because of the chemicals used. Crews also need to know about the possibility of strong winds (> 18 kts) or if precipitation in an area will start as rain, as both of these factors can reduce the effectiveness of road treatments (Pisano et al., 2004). Road crews also benefit from the judicious use of terms such as snow bursts and squalls, as it makes them more aware of the possibility of quickly changing conditions (DeVoor, 2004).

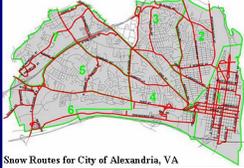
## Student Notes:

AWOC Winter Weather Track

### Sector Specific Issues: Municipalities and Road Maintenance



Photo: City of Alexandria, VA



Snow Routes for City of Alexandria, VA



- Need more detail for tactical than strategic
- Accurate real-time info critical

Most critical issues for road treatment: **Road temps, wind speed, intensities, and change in precipitation type**

## 12. Sector Specific Issues: Transportation

**Instructor Notes:** The needs of the general traveler or commuter differ a little bit from those of maintenance crews. Many commuters rely on the media or web sites for traffic information on weather delays. Smaller events usually result in greater delays (as much as 3-8 times as long) during rush hour vs. low volume times. Larger events can cause increases in commuting times of up to 100% or more. A new development in the last few years for many travelers is the 511 system, or the National Traveler Information Telephone Number. By the end of 2005, 511 was expected to be accessible by approximately 40% of the US population (DOT, 2005), primarily in the intermountain west, northern plains, and along the east coast. The 511 system is capable of relaying NWS warning and advisory products through phone services as well as via roadside displays, which can be a great resource for many longer distance travelers. Commercial transportation interests usually are looking for weather information out to at least 48 hours, with more detailed information at 24 hours (Truckerweather.com, 2005). That provides them the time they need to make changes in drivers routes to get them from point A to point B in the safest and most cost-effective way possible. While many companies in this sector rely on private forecasts, Winter Watch/Warning/Advisory products are still useful to them and fit well into their timing needs.

**Student Notes:**

AWOC Winter Weather Track

**Sector Specific Issues: Transportation**



DOT  
TRAVELER  
INFO  
CALL 511

- Rush hour delays disproportionately large for commuters
- 511 – National Traveler Information Telephone Number
- Commercial transportation

---

## 13. Sector Specific Issues: Aviation

**Instructor Notes:** Within the aviation community, the biggest area of concern is probably icing. It's certainly their biggest area of research (FAA, 2005). One of the FAA's future goals is to reduce the FAR for icing forecasts as standard icing products tend to outline too large a volume for icing conditions. Other research shows that the impact of ice and snow on aircraft performance depends on the liquid water equivalent of precipitation. The FAA is testing out some decision-making hardware and software systems to help airport and airline staff best determine liquid equivalent of precipitation so that they can plan their anti-icing activities accordingly to be more cost-effective and safe. Besides icing, low ceilings and visibilities are the other major concerns for the aviation community. Adverse ceiling and visibility conditions are cited as contributing factors in over 35% of all weather-related accidents in the US civilian aviation sector (Herzogh et al., 2002). Their goal is to improve the availability of ceiling and visibility from point data to a gridded system of observations and forecasts. Lastly, it's important to note some important timing issues with respect to commercial aviation. If a significant winter event occurs at a major hub airport, a commercial airline needs to know by 8 pm local time the day before the event, regardless of when the next day that event will occur, to successfully mitigate the impacts of the event. At least 24 hours lead time is preferred by most airlines, though. The airport itself needs at least 12 hours to spin up their mitigation efforts. It's important to remember that, even if an airport doesn't close during winter weather, flights are still likely to be cancelled due to de-icing operations. Given the same conditions, southern airports will likely have more flight cancellations during a winter event because they are less efficient at deicing operations (Qualley, 2006).

Student Notes:

AWOC Winter Weather Track

### Sector Specific Issues: Aviation

- Icing big concern
- AWC products address FAR, LE issues
- Low ceilings, visibilities also concerns
- Timelines for airlines and airports

## 14. Sector Specific Impacts: Emergency Managers

**Instructor Notes:** EMs, as a group, can be very knowledgeable about meteorology (although certainly not all of them are). While other user groups may comment that they get too much information, many EMs can't seem to get enough. The NWS survey of EMs indicate that many of them will ensemble as much weather information as they can find. They clearly rely on NWS products for winter events, giving these products a very high satisfaction score. But they also cited numerous other weather information providers as helping them do their job. There was a desire from them to actually see experimental forecast products that are discussed in NWS products and discussions. They also feel strongly about specific information since most EMs are only concerned with their local area. Several explicitly commented on the more specific threat winter warning and advisory products as a positive development. In the NWS surveys, many EMs expressed a desire for more coordination and communication between the NWS and them. Since many EMs utilize newer technologies to stay in touch with what's going on, they also expressed a desire for a more technological solution to the coordination and communication issue. Therefore, they prefer graphic and text combination products that are easy to understand, especially if they can download them on their cell phones, PDAs, etc.

Student Notes:

AWOC Winter Weather Track

### Sector Specific Impacts: Emergency Managers

- The more information, the better
- Specific info, too
- Desire more coordination, better communication

---



---

## 15. An Example of NWS & EMs Mitigating Societal Impacts: After the January 1998 Ice Storm

**Instructor Notes:** Here's an example of an office coordinating with local emergency managers to help them mitigate impacts. This WSW was issued following a massive ice storm that struck parts of the NE US and southern Canada back in January, 1998. The Maine Emergency Management Agency had asked the NWS to extend the WSW, despite sunny skies, because of the threat of falling, ice-laden tree limbs and power lines. Continuing the warnings in this circumstance kept the public aware and informed of the threat from this extreme event. Take a moment to view the text. When you are finished, push the play button to advance to the next slide.

**Student Notes:**

AWOC Winter Weather Track

**An Example of NWS & EMs Mitigating Societal Impacts: After the January 1998 Ice Storm**

WINTER STORM WARNING  
NATIONAL WEATHER SERVICE GRAY ME  
310 AM EST SAT JAN 10 1998

...WINTER STORM WARNING FOR FALLING TREE LIMBS...TREES...AND ICE TODAY FOR NORTHERN CENTRAL AND SOUTHEAST NEW HAMPSHIRE AS WELL AS CENTRAL AND SOUTHERN MAINE...

IN THE WARNING AREA THE WEIGHT FROM FREEZING RAIN ON TREES FROM THE RECENT ICE STORM WILL RESULT IN MORE FALLING TREE LIMBS...TREES...AND ICE. THIS MAY RESULT IN ADDITIONAL DOWNED POWER LINES. EVERYONE SHOULD BE EXTREMELY CAREFUL IN VENTURING OUT TODAY.

THE STORM SYSTEM THAT WAS RESPONSIBLE FOR THE MAJOR ICE STORM OF THE LAST 72 HOURS HAS MOVED TO THE EAST OF THE AREA. IN ITS WAKE SKIES WILL BRIGHTEN TODAY.

EVEN THOUGH THE LIKELIHOOD OF ADDITIONAL FREEZING RAIN HAS PASSED...THE THREAT AND DANGER FROM FALLING LIMBS...TREES...AND ICE IS EXTREME ENOUGH TO WARRANT THE CONTINUATION OF WINTER STORM WARNINGS.

THE NEXT STATEMENT WILL BE ISSUED BY 11 AM.

---



---

## 16. Sector Specific Issues: Schools

**Instructor Notes:** Another important user group is all of the local school districts and superintendents, who are generally the winter weather school closing decision-makers. Some of the details of their decision-making process varies regionally. For instance, some schools make closing decisions for winter weather the night before, while others wait until a couple of hours before school starts. Other schools have rules in place that once school starts, they will not do an early release, while others will not hesitate to conduct an early release. What is common among all schools is that they need to get weather information prior to their key decision-making times. For some, this time will be by the late night news, while for others it will be before 6 am that day. For schools that conduct early dismissals, those decisions are usually made between 11 am and 1 pm. When it comes to their decision-making process, a study by Czrnetzki (2003) showed that the primary factor in a superintendent's decision-making process was often the ongoing weather while they were making their decision. Many will personally drive roads in their area to determine if they are safe. Other factors, such as extremely low wind chills (~-35 F or lower) in rural areas, can lead to closures as well, even if the roads are drivable. Other influential factors in their decision-making were graphical weather forecasts

## Warning Decision Training Branch

on TV and the Internet, as well as decisions made by other superintendents. As a result, there can be a bit of a herd mentality in some areas if it is a close call on closure, with certain bellwether decision-makers sticking their necks out and then others following suit. These cases are especially common if, for example, smaller school districts share resources with each other, or with a larger school district, and an early release is necessitated by weather conditions.

### Student Notes:

AWOC Winter Weather Track

### Sector Specific Issues: Schools



- Superintendents key decision makers
- Need weather information prior to key decision times
- Decision-making time obs, graphical forecasts key
- Herd mentality

---

---

## 17. Learning Interaction #2

**Instructor Notes:** Take a few moments to complete this quiz.

### Student Notes:

---

---

## 18. Utilization: User Responses to Forecast Information

**Instructor Notes:** The previous slides have discussed some of the user issues and constraints that are out there. These last few slides will discuss user response. The general public has a great influence on a given event's impact based solely on their behavior (i.e., do they just stay home during a heavy snow event; Call, 2005). Utilization can range



Student Notes:

AWOC Winter Weather Track

### More on User Utilization of Forecast Information

Did You Know What Action to Take? (Internet Panel)

Response	Percentage
Know what action to take	54%
Don't know if actions were correct?	44%

From NWS (2005)

- Credibility, competency are both strengths
- Sensitive to users' concerns, timely products, and ease of access all key
- Need to clarify or resolve ambiguities for customers

## 20. Risk Perception and Personal Experience Important Part of User Response

**Instructor Notes:** Part of the issue of utilization also comes down to personal experience. People who are most likely to use our products are those who have experienced significant winter weather in the recent past. With this experience comes a better awareness of and greater likelihood to act upon potential weather-related impacts (Stewart, 2006). While significant portions of the US experience winter weather events regularly, a given area may not have recently experienced impacts similar to an upcoming forecast event. Even if they have, maybe they didn't personally experience the impacts of the previous events. People without these experiences of personal impact may be disinclined to utilize our products due to a low perception of personal risk (Yarnal et al., 2005). One way to overcome such a barrier is to highlight potential risks to users and put the possible impacts of the event in context for them. It is best however, to avoid reference to specific past events unless confidence is very high that the upcoming event will be similar to the referenced event and it is clearly the most effective way to put the event in context.

Student Notes:

AWOC Winter Weather Track

### Risk Perception and Personal Experience Important part of User Response

Photo: FEMA

Experiencing Event

Photo: FEMA

Experiencing Impacts of an Event

- Utilization varies based upon personal experience
- People need to experience impacts, not just events
- Need to overcome barriers to communicating risk

---



---

## 21. One Way to Tie it All Together: Call-To-Action Statements

**Instructor Notes:** One possible way to overcome users' barriers to utilization is through Call-to-Action statements. The text listed on this slide represent several different examples from watches, warnings, advisories, and statements. The first couple are fairly generic and are quite common to many winter products. The subsequent statements are a little more rare, depending on the portion of the country you live in and the severity of the event. Take a moment to review the statements. When you are finished, click the play button to advance to the next slide.

**Student Notes:**

AWOC Winter Weather Track

### One Way to Tie it All Together: Call-To-Action Statements

<p style="font-size: x-small; margin: 0;">IF YOU ARE PLANNING TRAVEL THROUGH FRIDAY MORNING...BE PREPARED FOR HAZARDOUS WINTER DRIVING CONDITIONS. ROADS WILL BE ICY AND SNOWPACKED. IN ADDITION...WIND DRIVEN SNOW WILL SERIOUSLY LIMIT VISIBILITY.</p>
<p style="font-size: x-small; margin: 0;">IF YOU MUST TRAVEL IN OR THROUGH THE WATCH AREA DURING THE TIME OF THE WATCH...TAKE ALONG A WINTER SURVIVAL KIT.</p>
<p style="font-size: x-small; margin: 0;">THOSE PLANNING TRAVEL SHOULD EXPECT TO ENCOUNTER DIFFICULT WINTER DRIVING CONDITIONS. STRONG WINDS WILL MAKE FOR HAZARDOUS DRIVING CONDITIONS FOR TRUCKS..CAMPER AND OTHER HIGH PROFILE VEHICLES.</p>
<p style="font-size: x-small; margin: 0;">PLEASE USE CAUTION IF YOU MUST BE OUT. COVER ALL SKIN TO PREVENT FROSTBITE. IN 60 BELOW ZERO WIND CHILL CONDITIONS FROSTBITE CAN OCCUR IN AS LITTLE AS TEN MINUTES.</p>
<p style="font-size: x-small; margin: 0;">WHEN USING GENERATORS...REMEMBER TO ALLOW FOR ADEQUATE VENTILATION. DO NOT RUN GENERATORS IN ENCLOSED AREAS BECAUSE CARBON MONOXIDE POISONING CAN EASILY KILL PEOPLE WITH NO WARNING.</p>

---

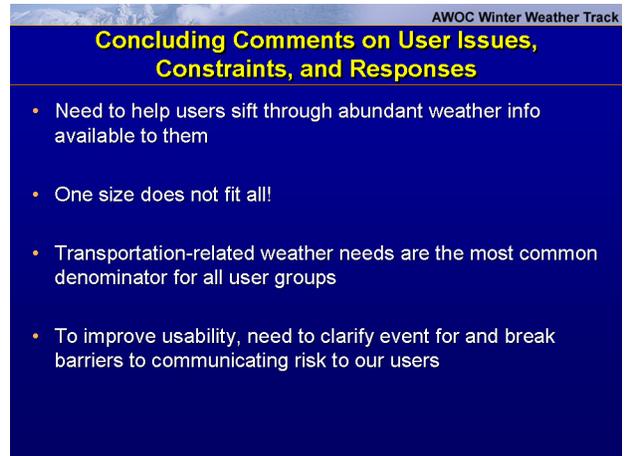


---

## 22. Concluding Comments on User Issues, Constraints, and Responses

**Instructor Notes:** For users, getting the right information is a critical issue. For some there is too much and for others there is not enough. What is important is that we do what we can to help users sift through the abundant weather information available to them. In doing so, it is important to remember that one size does not fit all. There are some common themes that run across all groups, such as impacts on transportation that affect almost all user groups. There were other specific needs and/or wants from individual groups discussed as well. User response is a trickier issue. Statistics from the NWS surveys suggest that our users think we are doing very well when it comes to our winter weather products and services. The survey suggests that there is a strong understanding and application of our winter weather watch and warning products. We already do many of the things an organization should do to improve usability, so where do we go from here? Besides keep on keeping on, we can try two things. Working to make sure our products help users clarify or resolve any ambiguities they have in their decision-making and communicate the potential personal risks for an impending event.

**Student Notes:**



AWOC Winter Weather Track

### Concluding Comments on User Issues, Constraints, and Responses

- Need to help users sift through abundant weather info available to them
- One size does not fit all!
- Transportation-related weather needs are the most common denominator for all user groups
- To improve usability, need to clarify event for and break barriers to communicating risk to our users

---

---

## 23. References Cited in This Lesson

**Instructor Notes:** This slide contains a list of all the references cited in the slides, mentioned by the speaker, or placed in the speaker notes. The full references are listed at the end of the student handouts for IC 3, Lesson 2.

**Student Notes:**



AWOC Winter Weather Track

### References Cited in This Lesson

- Call, 2005
- Czrmetzki, 2003
- DeVoir, 2004
- DOT, 2005
- FAA, 2005
- Hallowell and Blaisdell, 2003
- Herzegh et al., 2002
- Mahoney, 2003
- NWS, 2005
- Pisano et al., 2004
- Qualley, 2006
- Shafer, 2005
- Stewart, 2006
- Transportation Research Board, 1991
- Truckerweather.com, 2005
- Weiss, 1979
- Yarnal et al., 2005

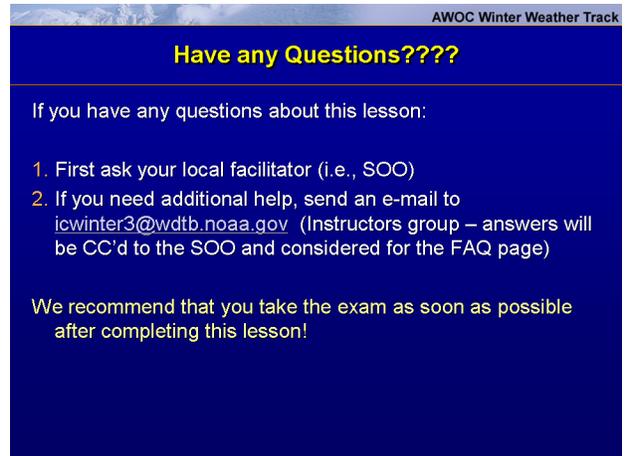
---

---

## 24. Have any Questions????

**Instructor Notes:** If you have any questions about this lesson, first ask your local AWOC facilitator. If you need additional help, send an E-mail to the address provided. When we answer, we will CC your local facilitator and may consider your question for our FAQ page. We strongly recommend that you take the exam as soon as possible after completing this lesson.

**Student Notes:**



AWOC Winter Weather Track

**Have any Questions????**

If you have any questions about this lesson:

1. First ask your local facilitator (i.e., SOO)
2. If you need additional help, send an e-mail to [icwinter3@wdtb.noaa.gov](mailto:icwinter3@wdtb.noaa.gov) (Instructors group – answers will be CC'd to the SOO and considered for the FAQ page)

We recommend that you take the exam as soon as possible after completing this lesson!

**Warning Decision Training Branch**