Winter Maintenance
Snow and Ice Control
– Module 1 –
• T² Centers or LTAPs located in all 50 states
• Funded by FHWA and state DOTs
• Mission – promote training, tech transfer, research implementation at local level
• Delaware T² hosted by University of Delaware, part of Delaware Center for Transportation
• Delaware T² funded by FHWA and DelDOT
Today’s Instructors:
- Matheu J. Carter, P.E. – Municipal Engineering Circuit Rider
- Roger K. Bowman – Manager, Facilities-Grounds Services, University of Delaware

Restrooms, etc.

Standard Reminders:
- Cell phones, pagers, beepers, walkie-talkies
- Sidebar conversations
More Preliminaries

- Questions – any time
- We’re a small crowd – let’s keep it interactive and informal
- Sharing of thoughts or examples – any time
The T² Center Winter Maintenance Program

What we cover:

- Module 1 – Introduction to snow and ice control
- Module 2 – Planning/program development
- Module 3 – Pre-season activities
- Module 4 – Operations/in-season activities
- Module 5 – Post storm activities
- Module 6 – Post season activities
Acknowledgements

Primary references:

- AASHTO Guide for Snow and Ice Control
- APWA, New England Chapter
  - “Plow Power” and “White Gold”
- Salt Institute
- National Local Technical Assistance Program (LTAP)
- Iowa Department of Transportation
- NCHRP
  - Report 526 - Snow and Ice Control: Guidelines for Materials and Methods
  - Report 577 - Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts
Acknowledgements

Our collaborators and counselors (with our thanks):

- Brian Urbanek, Alastair Probert, Edwin Tennefoss - DelDOT
- Brad Dennehy – Town of Milford
- Roger Bowman – University of Delaware Facilities Management
- Daniel Webber – Roads Division, Cecil County, Maryland
- The national LTAP/T² community
Introduction

In this module:

- General objectives of snow and ice control
- Weather basics
- Importance of training
- Innovation and evolution
- Safety, risk management, liability
What’s Position Do You Play?

Show of hands – where do you fit in?

- **Team Owner** – I don’t do it, but I pay for it
- **Head Coach/Manager** – I make all the trains run on time and I take the angry phone calls
- **Quarterback** – I call the plays on the ground and direct the action
- **Lineman** – I’m on the front lines
- **Team Doctor** – I fix what they break
Where Are You in the Game?

Regardless of where are you now:

- We hope you’ll have a greater command when we’re done
- Don’t imagine this workshop will make you an expert (unless you already are one) – practice will do that
- As we go, share your challenges, experiences, and solutions – let’s all learn from each other

Ok – hammer down
Where Are You in the Game?

- Professional snow fighters
- An important part of the community safety team
Objectives of Snow and Ice Removal

- Safety
  - Movement of emergency responders
  - Public safety
  - Safety of snowfighters

- Performance
  - Define levels of service and achieve them

- Cost effectiveness

- Environmental protection

- Accessibility, mobility, connectivity

- Economic vitality, tourism
Winter Weather Impacts

- Traffic crashes
  - Fatal
  - Non-fatal
  - Vehicles
  - Pedestrians

- Increased travel time, fuel costs
- Increased insurance premiums
- Decreased mobility
- Decreased productivity
Winter Weather Impacts

Video

from the Salt Institute

Winter Maintenance Training – Delaware T Center
Winter Operations

- Winter operations entail many “uncontrollable factors”
- Particularly when compared to other public works projects or programs
- What are these uncontrollable factors?
Weather Elements

- Amount of Snow
- Rate of Snow
- Duration of Snowfall
- Timing of Storm
- Temperature
- Wind Conditions
- Type of snow (wet/dry)
Road & Site Conditions

- Topography / Site Conditions

- Sharp curves
- Bridges
- Cul-de-sacs
Traffic: Type, Speed, Volume

Truck Traffic

High-speed Expressway

Heavy Volume

Low Volume
Drivers & Vehicles

- Driver Attitudes
- Stalled or Abandoned Vehicles
Elements of a Snow and Ice Control Program

- Goals and expectations, including levels of service
- Priorities for resource allocations and maintenance activities
- Fiscal accountability
- Recognition of legal responsibilities and constraints
- Environmental protection
- Public education/outreach
- Flexibility to react to changing conditions
- Opportunity to innovate and experiment
Levels of Service (LOS)

- **Balance** – must satisfy the public but be attainable
- **Defines conditions at one or more stages**
  - End of storm
  - Intermediate stages
  - Acceptable condition without action
- **Requires many considerations**
  - Local policy or ordinance limits
  - Road classifications and traffic volumes
  - Available equipment and materials and location of facilities
  - Personnel rules
## Levels of Service (LOS)

### (Just) Examples

<table>
<thead>
<tr>
<th>Classification</th>
<th>Traffic Volume (AADT)</th>
<th>Hours per Day of Response Activity</th>
<th>Level of Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Commuter</td>
<td>10,000-30,000</td>
<td>24</td>
<td>All lanes substantially bare pavement before coverage time reduced</td>
</tr>
<tr>
<td>Urban Collector</td>
<td>500-5,000</td>
<td>18</td>
<td>75% bare pavement</td>
</tr>
<tr>
<td>Urban Residential</td>
<td>200-500</td>
<td>12</td>
<td>75% bare pavement</td>
</tr>
<tr>
<td>Secondary Street</td>
<td>&lt;800</td>
<td>12</td>
<td>One wheel path in each lane will have intermittent bare pavement with treated hills/curves before coverage time reduced</td>
</tr>
</tbody>
</table>
Levels of Service (LOS)
Levels of Service (LOS)
Environmental Considerations

- **Things to think about**
  - Controlling runoff from roadway operations
    - Streams
    - Groundwater
    - Vegetation
    - Habitat
    - Bridges, pavement, appurtenances
  - Storage of abrasives and chemicals
  - Protecting employees from chemical and abrasives dangers
  - Minimizing air quality impacts
Innovation, Experimentation, Evolution

- Organization and individual managers should be open to new ideas (and even old ideas that need a fresh look)
- Abrasives versus chemicals versus mixes
- Alternatives to traditional rock salt – use of other freeze point depressants
- Brines and anti-icing approaches
- Alternative equipment
Example – Seattle Department of Transportation

- 2008 storm crippled the city
- 26 plows, 4 deicing trucks equipped with GPS
- 2,200 tons salt and 46,500 gallons salt brine in storage
- New “Winter Weather Response” webpage
  - Shows where plows have been in last hour, 3 hours, 12 hours
  - Links to traffic cameras
- Clear levels of service projections
  - Level I (transit, emergency responders) cleared 8 hours after storm
  - Level II – one lane each direction bare and wet
  - Level III – clear problem spots (hills, curves, stopping zones)
- “Snow Watch” tracks and forecasts at neighborhood level
- Additional temperature sensors on bridges
Weather Basics

- **Snow**
  - Ice crystals form gangs way up high and float down innocently
  - Sustained snowfall requires constant inflow of moisture
- **Ice**
  - Moisture gets on stuff that’s cold – nobody likes that
- **Black ice**
  - Forms when the air temp is below freezing but warmer than the pavement temp (e.g., air at 30°F and pavement at 26°F)
  - Look for when the dew point and air temp converge - air can no longer hold the moisture – condenses on the pavement
- **Sleet**
  - Cold, deep layer of air at surface cause raindrops as they descend
- **Freezing rain**
  - Water droplets fall from above-freezing layer to below-freezing layer
Weather Basics

- Recognizing what **has** happened, what **is** happening, and what is likely **to** happen...
  - Snow
  - Ice
  - Black ice
  - Sleet
  - Freezing rain

- Helps guide us what to do at any given point in the storm
  - Start treatment
  - Change treatments
  - Stop
  - Pause
Weather Basics

- Weather information to watch
  - Temperatures
    - Air
    - Pavement
    - Subsurface
  - Dew point
  - Wind
    - Speed
    - Direction

- Where do we find it
  - Weather Channel/weather.com
  - NOAA
  - DelDOT
  - On-site weather station
  - Finger in the air?
Importance of Training

- Improve our snow fighting forces
  - Efficiency
  - Consistency
  - Effectiveness
- Minimize damage to snow/ice fighting equipment
- Minimize damage to roadways, curbs, signs, sidewalks, mailboxes...
- Increase safety for
  - The snowfighter
  - The pedestrian
  - The motorists
  - The kids
  - The ATVer ...
Importance of Training

- New equipment
- Crews
  - Personal protective equipment
- Materials handling
  - Vehicles and equipment
  - Operations
- Policies
- Training
- Safety committee
- Tailgate safety talks
Importance of Training

- Simulator training
Importance of Training

• Simulator training
Importance of Training

- Simulator training

Snowplow Simulator Training Evaluation—Final Report 585; AZDOT
Winter Maintenance Training — Delaware T® Center
Importance of Training

- Simulator training
  - Increased use in our area
    - Cecil County, Maryland
    - Elkton, Maryland
    - DelDOT
Remember:
Protecting Pedestrians, Motorists, and Our Own Snowfighters is Job #1
Fostering Innovation and Evolution

- New equipment
- New materials
- New uses of traditional equipment/materials
- Requirements of the Americans with Disabilities Act (ADA)
- Multi-modal objectives
Duty concerning snow and ice

- Generally, courts say agencies have no duty to undertake precautionary or remedial action...
- Urban governments may have greater duty to clear streets...
- No duty to [clear snow...] in absence of weather hazard not reasonably apparent to person exercising due care...
- No duty...to remove general accumulations unless agency has notice of a dangerous/hazardous condition caused by snow/ice
- Duty to exercise reasonable care – alleviate or give warning
- General rule – no duty to remove general accumulations...
- Where notice of hazard, duty to exercise reasonable care...
- Plaintiff has burden of proving duty owed, breach of duty, breach proximately caused incident, and agency had constructive or actual notice of the conditions
Tort Liability

- Duty must be measured by number of factors
  - Size of task (geography, etc.)
  - Severity of storm
  - Available resources
  - Practicality of treatment
- Plaintiff must demonstrate harm outweighed utility
- Most dangers are known to travelers – impossible not expected
- Liability may be based on agency-created defect
- But patch of ice by itself imposes no liability
- Not liable where agency exercised due diligence
- Duty to apply chemicals often considered reasonable care
- Summary – courts often impose duty of reasonable care
Tort Liability

- Trespass/Nuisance
  - Damage to abutting property by snow/ice operations
  - Sue for nuisance, trespass, or inverse condemnation
  - “Unreasonable or excessive” salting?
  - Might be treated as any other invasion of property or interference with quiet enjoyment
  - Court even entertained the notion that if injury is severe, it could constitute a “taking”
Winter maintenance carries dangers, risks
- Some risks we can control or affect; others not
- Start by knowing the difference
- Perhaps others can control things we cannot – law enforcement for example

Obligation to operate safely and use safe equipment
- No place for “cowboys”
- Have all summer to check brakes, hydraulic lines, etc.

Safety plan
- Has to be sound, simple, straightforward
- Has to apply to everyone in organization
- Has to be clearly supported by all layers of management
Good safety plan can:
- Reduce lost work time
- Reduce equipment costs
  - Less repairs
  - Less equipment downtime
- Reduce operating costs
  - Insurance premiums
  - Workman’s Compensation
- Increase productivity
- Improve quality of service
- Improve community relations
- Increase employee stability, loyalty, and motivation
Safety, Risk Management, Liability

- Safety culture starts with management
  - Supervisors should be held accountable
- Recognize and correct unsafe behavior
  - Horseplay or improper equipment use creates risk
- Investigate crashes and near misses
  - No “witch hunt” necessary – just find out what happened
  - Make corrections, communicate with crews
- Develop standard operating procedures (SOPs)
- Safety rodeos and training
- Reward safety
Safety, Risk Management, Liability

**Equipment safety**
- Comprehensive vehicle maintenance – before storms
  - Brakes
  - Power trains
  - Hydraulic systems
  - Tires
  - Lights, wipers, mirrors
  - Dump body operations
  - Fluids
  - Cutting edges
- Mechanical checks during and after storms
- Many crashes come from mechanical failure or operator error – we can control both to a large degree
- Breakdowns less likely – less downtime
Safety, Risk Management, Liability

- Safety gear
  - Tools for minor maintenance
  - Fire extinguishers
  - Retroreflective triangles, flares, or breakdown warning signs
  - Retroreflective vest (ANSI Class 3)
  - Gloves
  - Foul weather gear
  - Flashlights
  - First aid kit
Safety, Risk Management, Liability

• Public safety – operators should
  o Obey traffic laws
  o Watch speed, stopping distances, turning radii, skid control
  o Avoid making sudden moves
  o Avoid pushing snow
    ▪ Over bridge rails
    ▪ Onto sidewalks
    ▪ Into storefronts
  o Keep to right approaching oncoming traffic
  o Control material spinners relative to vehicles and pedestrians
  o Report stranded motorists
Safety, Risk Management, Liability

- Operational speeds
Safety, Risk Management, Liability

- Operational speeds
Safety, Risk Management, Liability

- **Public safety – traveling public should**
  - Stay off roads until after storm cleanup, if possible
  - Obey traffic laws – including Move Over Law
  - Avoid walking in vehicle travelways
  - Watch speed, stopping distances, skid control
  - Avoid making sudden moves
  - Keep to right approaching oncoming plows/equipment
  - Report stranded motorists

- **This can be part of pre-season public relations; we’ll see more of this in Module 3**
• Drugs and alcohol
  o Should be no tolerance
    § Operators
    § “Second seaters”
    § Any other essential personnel
  o Commercial Drivers License (CDL)
    § DOT - Omnibus Transportation Employee Testing Act of 1991
    § Positive test – employee immediately removed from safety-sensitive functions
  o Don’t forget your contractors
    § They should comply with the same policies that you use
Multi-Modal

- Don’t forget – it’s more than just roads these days
  - Pedestrian pathways
  - Bicycle routes
Multi-Modal

- You don’t necessarily have to do it by hand
Multi-Modal

- The intrepid cyclist
  - On a bike
  - In the snow
  - At night
Elected Officials – Jump In

- Get involved
  - Visit Your Public Works Facilities
  - Talk to Your Snowfighters
  - Ride a Plow Truck During a Winter Storm

[Images of public works facilities and snowplow operators]
What is/are in the Other Modules?

- **Module 2 – Planning and Program Development**
  - Snow and ice removal plan
  - Standard operating procedures
  - Route maps/assignments
  - Review and updating plans periodically
  - Budgeting
  - Acquiring and renting equipment
  - Recordkeeping
  - Preparing elected officials
  - Preparing the public
What is/are in the Other Modules?

- **Module 3 – Pre-Season Activities**
  - Personnel training and refreshers
  - Stakeholder briefings
  - Contracting and material acquisition
  - Storage and handling materials
  - Equipment readiness
  - Crew and equipment assignments; practice runs
  - Snow markers and passive control devices
  - Check/clear drainage ways
  - Calibrate spreaders and other equipment
  - Public service announcements and bulletins
What is/are in the Other Modules?

- Module 4 – Operations/In-Season Activities
  - Chain of command
  - Inspect road conditions
  - Safety meetings
  - Plowing techniques
  - Abrasives and freeze point depressants
  - Weather information
  - Recordkeeping
  - Special areas

- Worst case weather scenarios
- Disabled, inoperative, abandoned vehicles
- Disposal of snow/environmental concerns
- Safety
- Day versus night operations
- Meals
- Dealing with the public
What is/are in the Other Modules?

- **Module 5 – Post Storm Activities**
  - Push back shoulders
  - Clear drainage ways
  - Refreezing
  - Maintain and clean equipment
  - Restoring safety features and sight distances
  - Removal of snow
  - Asset inventory
  - Interim pavement repairs
  - Assess performance and debrief
What is/are in the Other Modules?

- **Module 6 – Post Season Activities**
  - Inventory equipment and materials
  - Clean and repair equipment
  - Store equipment
  - Review of performance and safety statistics
  - Brief elected officials and bean counters
  - Plan for replenishment of materials
  - Road and shoulder repairs
  - Assess the season
  - Calibrate plan accordingly
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