Today’s Instructor:
- Matheu J. Carter, P.E.
  - Municipal Engineering Circuit Rider

Restrooms, safety exits, smoking policies, etc.

Standard Reminders:
- Cell phones, pagers, beepers, walkie-talkies
- Sidebar conversations
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 – Delaware Department of Transportation
- Brad Dennehy – Town of Milford, Delaware
- 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
Where Are You in the Game?

- Professional snow fighters
- An important part of the community safety team
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
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

- Bridges
- Sharp curves
- 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)
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
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 ice pellets 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
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
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
Innovation, Experimentation, Evolution

- 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
Fostering Innovation and Evolution

- New equipment
- New materials
- New uses of traditional equipment/materials
- New outreach/communication methods
- 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 concerning snow and ice (cont’d)

- 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

- (Legal) 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”

- **Involve your legal counsel when in doubt**
Safety, Risk Management, Liability

- **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
Safety, Risk Management, Liability

- 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 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
Public safety – operators should

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

- Operational speeds
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
- Stay back where operators can see you in mirrors
- Be aware – equipment backs up and operators can’t always see
- 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

Video
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

Winter Operations: Survival Lessons for Public Officials
Winter Maintenance Training – Delaware T² Center
Matt Carter
Municipal Engineering Circuit Rider
Delaware T² Center
matheu@udel.edu
(302) 831-7236

http://www.ce.udel.edu/dct/T2.html

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