Winter Maintenance Snow and Ice Control – Module 2 –

PLANNING AND PROGRAM DEVELOPMENT

Delaware T²/LTAP

PRESENTED BY:

DELAWARE T²/LTAP CENTER

Introduction

In this module:

- 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

Planning Documents

- Snow and Ice Control Ordinance, Resolution, or Policy
  - Elected official level, typically
- Winter Maintenance Plan
  - Senior management
  - Consultation with staff
- Standard Operating Procedures (SOPs)
  - Senior management
  - Consultation with staff

Winter Maintenance Ordinance

- Might be an ordinance, a resolution, a policy
- Who is in charge?
- Authority hierarchy between agencies like Public Works, the Police Department, Fire and Rescue teams, etc.
- When is snow and ice removal activity initiated?
  - Some depth of snow?
  - What about ice?
  - How much ice?
  - Who makes this call?
- Expectation of street adjoiners for maintenance of sidewalks and curb ramps?
- Levels of Service?

Snow and Ice Removal Plan

- Objectives
  - Safety
  - Performance
  - Cost effectiveness
  - Environmental protection
  - Accessibility
  - Economic protection
- Levels of service
  - Define…
  - But leave room for response to conditions on the ground

Snow and Ice Removal Plan

- Level of Service
- Areas of Responsibility
- Winter Organization Chart
- Public Policies
- Storm Warning System
- Snow Map
- Personnel Policies
- Material Policies
- Equipment Policies
- Equipment Policies
- Operations Policies
- Intergovernmental Agreements
- Public / Media Relations

Snow and Ice Removal Plan

- Levels of service - variables
  - Snow...or ice? Or both? Or one then the other?
  - Heavy, wet snow or light fluffy snow?
  - Ice source - sleet or freezing rain? Or black ice?
  - When did it last precipitate? How much residue is left?
  - Pavement temperature prior to storm?
  - Early winter, mid winter, or late winter?
  - Weather conditions before, during, and after?
  - Manpower availability, overtime issues?
  - Equipment up-time
  - Material storage and inventory

Snow and Ice Removal Plan

- Levels of service
  - Targets during the storm
  - Tougher goals after the storm
  - "Doable" and practical
  - Optimal after the storm
    - 'Bare pavement maintenance' - driveway to destination

Snow and Ice Removal Plan

- Levels of service – elements
  - Bare pavement, 75% bare, 50% bare, passable one lane…
  - Throughout storm, 2 hours after, 8 hours after, next day…
  - Two lanes passable, just one…
  - Hours of response activity – 24 hours/day, 12 hours…
  - ADT driven response – constant clearing for >2,000 ADT, daytime clearing only below 200 ADT…
  - Treatment for ice – hills, intersections, school areas…
  - Remember our Seattle DOT example from Module 1

Snow and Ice Removal Plan

- Levels of service
  - Bare pavement maintenance
    - Plow and deicer (and/or anti-icing)
  - Center bare only
    - Limited plow and deicer
  - Plow roads, treat intersections
    - Plow and deicer or abrasives
  - Snowpack roads
    - Plow and abrasives (traction)

- Levels of Service
  - Centerline bare
  - Wheel path bare
  - Loose snow covered (percent area and depth)
  - Packed snow covered (percent area and depth)
  - Bare (percent area)
  - Thin ice covered (percent area)
  - Thick ice covered (percent area)
  - Dry
  - Damp
  - Slush (percent area and depth)
  - Frost
  - Wet

NCHRP Report 526
Snow and Ice Control: Guidelines for Materials and Methods

Snow and Ice Removal Plan

- Levels of service
  - Some plans get <u>very</u> detailed…

TABLE 1 Descriptions of pavement snow and ice conditions (PSIC)

Condition 1: All snow and ice are prevented from bonding and accumulating on the road surface. Bare/wet pavement surface is maintained at all times. Traffic does not experience weather-related delays other than those associated with wet pavement surfaces, reduced visibility, incidents, and "normal" congestion.
Condition 2: Bare/wet pavement surface is the general condition. There are occasional areas having snow or ice accumulations resulting from drifting, sheltering, cold spots, frozen melt-water, etc. Prudent speed reduction and general minor delays are associated with traversing those areas.
Condition 3: Accumulations of loose snow or slush ranging up to (2 in.) are found on the pavement surface. Packed and bonded snow and ice are not present. There are some moderate delays due to a general speed reduction. However, the roads are passable at all times.
Condition 4: The pavement surface has continuous stretches of packed snow with or without loose snow on top of the packed snow or ice. Wheel tracks may range from bare/wet to having up to (1.5 in.) of slush or unpacked snow. On multilane highways, only one lane will exhibit these pavement surface conditions. The use of snow tires is recommended to the public. There is a reduction in traveling speed and moderate delays due to reduced capacity. However, the roads are passable.
Condition 5: The pavement surface is completely covered with packed snow and ice that has been treated with abrasives or abrasive/chemical mixtures. There may be loose snow of up to (2 in.) on top of the packed surface. The use of snow tires is required. Chains and/or four-wheel drive may also be required. Traveling speed is significantly reduced and there are general moderate delays with some incidental severe delays.
Condition 6: The pavement surface is covered with a significant buildup of packed snow and ice that has not been treated with abrasives or abrasives/chemical mixtures. There may be (2 in.) of loose or wind-transported snow on top of the packed surface due to high snowfall rate and/or wind. There may be deep ruts in the packed snow and ice that may have been treated with chemicals, abrasives, or abrasives/chemical mixtures. The use of snow tires is the minimum requirement. Chains and snow tire equipped four-wheel drive are required in these circumstances. Travelers experience severe delays and low travel speeds due to reduced visibility, unplowed loose, or wind-compacted snow, or ruts in the packed snow and ice.
Condition 7: The road is temporarily closed. This may be the result of severe weather (low visibility, etc.) or road conditions (drifting, excessive unplowed snow, avalanche potential or actuality, glare ice, accidents, vehicles stuck on the road, etc.).

Snow and Ice Removal Plan

- Levels of service
  - Which…maybe…is more complicated than we need

TABLE 6 Example of level of service assignment

Highway segment		LOS class[a]	Within-event LOS		After-end-of-event LOS	
Route	Mile post		PSIC	Maximum snow accumulation (in.)	PSIC	Hours after end-of-event
15	2-25	2	3	1.5	1	2.0
8	175-186	4	5	2.0	2	6.0
16	37-51	3	4	1.5	2	3.0
5	256-271	3	4	1.5	2	3.0
2	0-4	2	3	1.5	1	2.0
10	277-291	4	5	2.0	2	6.0
10	291-315	3	4	1.5	2	3.0
4	26-32	1	2	1.0	1	1.5
4	32-50	3	4	1.5	2	3.0
Main Street	–	1	2	1.0	1	1.5
Baxer Bridge	–	1	1	0.0	1	0.0

[a] "1" is the highest; 4 is the lowest LOS class.

Snow and Ice Removal Plan

- Priorities
  - Traffic volume (ADT)
  - Type of street (subdivision, side, collector, arterial)
  - Condition and known problem areas of streets
  - Evacuation routes
  - School bus, transit, and other collection/distribution routes
  - Facilities for emergency responders (including your own)
  - Traffic convergence areas
  - Historic storm challenges (like drifting or flooding)

Snow and Ice Removal Plan

- Performance measure
  - Indices
    - e.g., amount of time a pavement is, say, <95% bare
    - 1 hour out of a 10 hour storm = 10%
    - i.e., higher is <u>not</u> better in this case
    - Consider the psychology of these
  - Miles plowed per hour
  - Tons material spread
  - Time from end of event to bare pavement or other condition
  - Safe achievable speed of travel at some time after event (perhaps as % of posted)
  - Customer satisfaction surveys

Snow and Ice Removal Plan

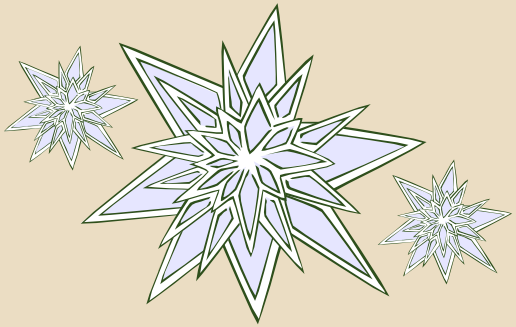
- Factors that influence performance results
  - Funding – of course, but what else?
  - Contingency resources
    - "Office" personnel as second seaters
    - Contractors
  - Optimal routes
  - Training
  - Pre-season pavement condition
  - Special situations
    - Depressed roads between two open fields – road closed
  - Public outreach – get them on your side

Snow and Ice Removal Plan

- Performance analyses and reporting
  - Don't wait for others to do this – take the initiative
  - Know what the targets, milestones, metrics are – take charge in developing them
  - The metrics may have to be broken down by storm type
  - Think about whether they should be published in your plan
  - Frame the terms of success and then target your operation towards achieving it

Snow and Ice Removal Plan

- Take away point – Flexibility, Improvisation, Innovation
  - You can't avoid accountability – you shouldn't try
  - But performance measures have to be reasonable
  - Any criteria must recognize that, like snowflakes, no two storms are alike



Snow and Ice Removal Plan

- Manpower
  - Generate lists with 24-hour contact info (including contractors)
    - Who is on call, when?
    - Expected response time?
  - Telephone/text/email/pager/Twitter tree
  - Identify process for meals
    - Paid for or on their own?
    - When? Who determines?
    - Time paid for?
  - Rest facilities
  - Incident procedures

Snow and Ice Removal Plan

- Manpower
  - Driver fatigue
    - Shift considerations
      - 12 on 12 off? Go till you drop? No right answer, but…
      - Driver fatigue is important safety issue and a liability concern
    - Limits on work hours
  - Effect of injuries or sick employees
  - Auxiliary personnel
    - Sewer/water department
    - Parks/recreation department
    - Solid waste department
    - Specialty crews (bridge , signs, weed control, etc.)
    - Office personnel
    - Temporary/seasonal

Snow and Ice Removal Plan

- Manpower
  - Reporting for duty
    - On call – who is and what does that mean?
    - Communications – tell them what is expected
    - Work rules – unions or not – what are they?
    - Can they get there when called?
    - Overtime pay, premium pay, minimum call in pay
  - Taking care of family
    - Can't (generally) during the storm
    - Prepare in advance to the extent possible
    - Arrange for friends and family to take care of the homestead
  - Drug and alcohol policy

Snow and Ice Removal Plan

- Manpower
  - Uniforms and gear
    - Who provides – employee or employer?
      - Either way ok, but make sure everyone knows so they can be prepared
    - Severe weather gear
      - From boots to gloves to hats
      - Designed to keep them warm and dry
    - Safety gear
      - Safety vests, hard hat, ear protection
      - Fire extinguishers
    - Emergency gear
      - Basic tools
      - Flashlight
      - First aid kit
      - Flares and/or triangles

Snow and Ice Removal Plan

- Equipment
  - Trucks
  - Plows
  - Wheel loaders
  - Material spreaders
  - Brine distributors
  - Motor graders
  - Snow blowers
  - Hydraulic sweepers
  - Snow melters

- Support Equipment
  - Welders and torches
  - Wrecker/haulers
  - Transport trailers
  - Fuel trucks
  - Mechanics trucks
  - Salt/sand barns/bins
  - Brine mixing tanks

Snow and Ice Removal Plan

- Equipment inventory
  - Agency owned
  - Contractor owned
  - Borrowed from sister agency
  - Rental equipment
  - Contingency equipment
  - Location
  - Size, capacity, capability
  - Condition
  - Inventory of spare parts, consumables (cutting edges)

Snow and Ice Removal Plan

- Trucks
- Motor graders
- Loaders

Snow and Ice Removal Plan

- Trucks
  - Ample horsepower
  - Suitable tires
  - Heavy duty axles
  - Built for strength and endurance

Snow and Ice Removal Plan

- Motor Graders
  - Good visibility
  - Heavy duty, durable
  - Versatile
  - Can be fitted with all types of plows

Snow and Ice Removal Plan

- Loaders
  - Can handle all types of plows
  - Maintaining storage areas
  - Loading trucks
  - Snow removal
    - Downtown streets
    - Cul-de-sacs
    - Bridges
    - Heavy drifts

- Multi-purpose tool carriers
  - Versatility

Snow and Ice Removal Plan

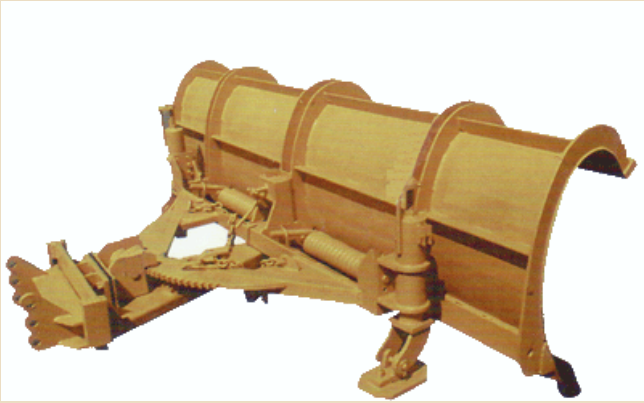
- Plows
  - Types
  - Trip type blades
  - Blade materials
  - Accessories
    - Shoes, skids, etc.
    - Snow deflectors
    - Guards, guides
    - Lights, heaters

Snow and Ice Removal Plan

- One way plows

Snow and Ice Removal Plan

- Reversible plows



Snow and Ice Removal Plan

- Airport plows

Snow and Ice Removal Plan

- Variable geometry plows

Snow and Ice Removal Plan

- Under body plows
- Wing plows

Snow and Ice Removal Plan

- V-plows
  - Used in heavy snow accumulations
  - Effective for clearing drifts
  - Great for sidewalks too

Snow and Ice Removal Plan

- Snow pushers/box plows
  - Clearing large plaza areas
  - Parking lots, etc.

Snow and Ice Removal Plan

- Trip blades
  - Less shock to equipment/operator
  - Allows faster speeds

Photo: Arctic Sectional Sno-Plow

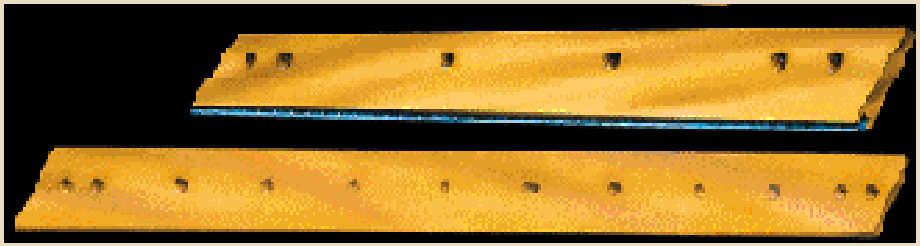
Snow and Ice Removal Plan

- Tow plows
  - ~$100K
  - Used in high snow areas
    - Utah
    - Minnesota
    - Pennsylvania
    - Missouri, etc.
  - "What keeps the trailer from swinging all over the place?"
    - "The position of the tow plow is control by hydraulic rams connected to the hitch and by steerable axles on the tow plow itself. The hydraulic rams do not require as much force as one would think, as the steerable axles keep the plow running straight and true." - Lynn Bernhard UDOT Maintenance Division

See "Tow Plow" on YouTube

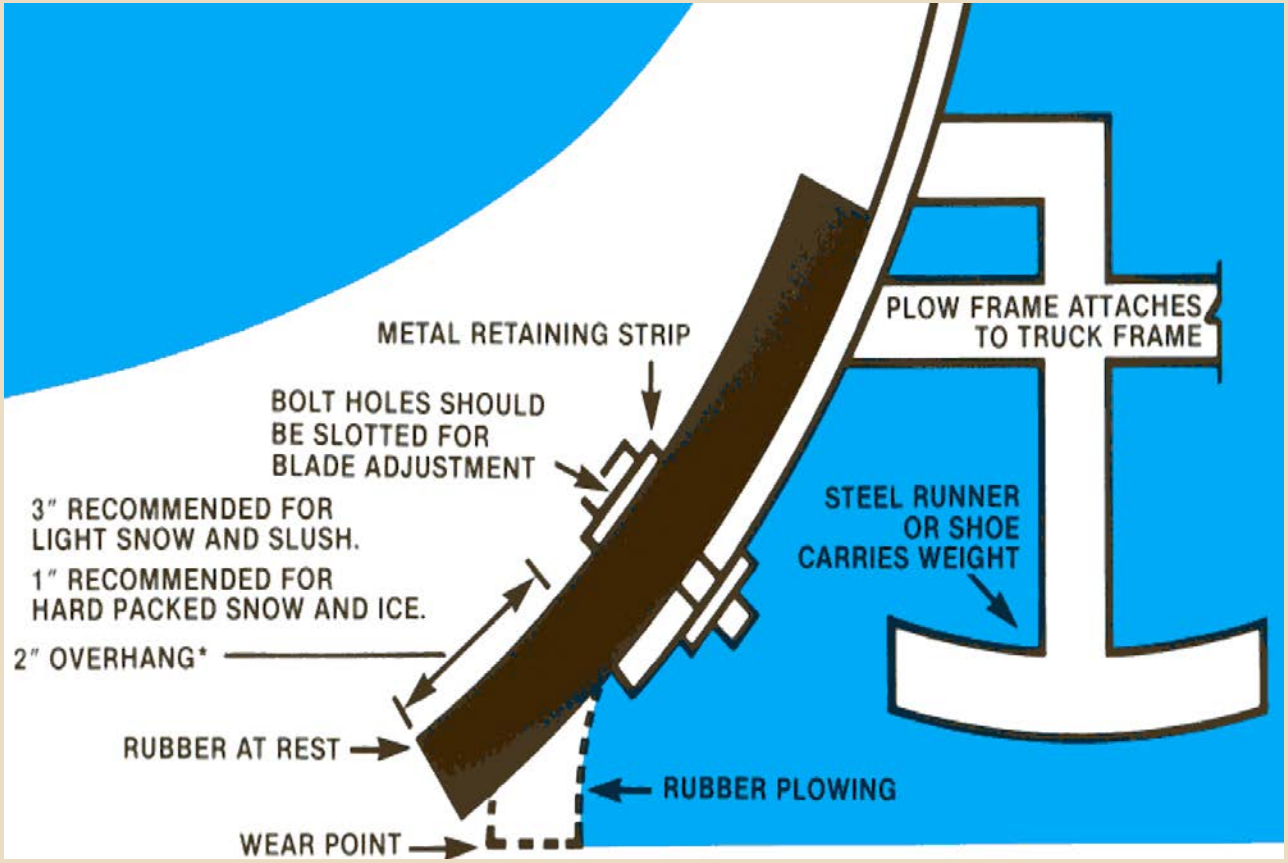
Snow and Ice Removal Plan

- Cutting edge materials
  - Steel
  - Carbide inserts
  - Ceramic inserts
  - Rubber
  - Polymer



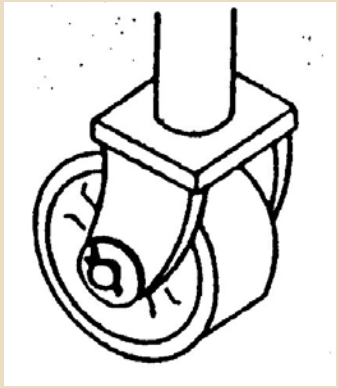
Snow and Ice Removal Plan

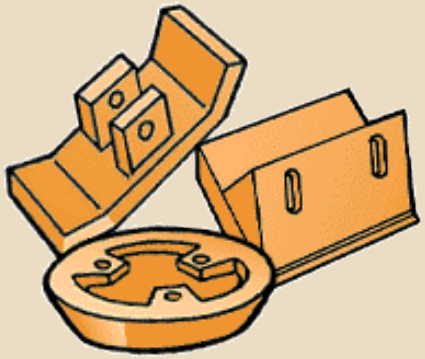
- Rubber cutting edges

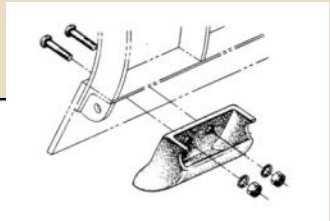


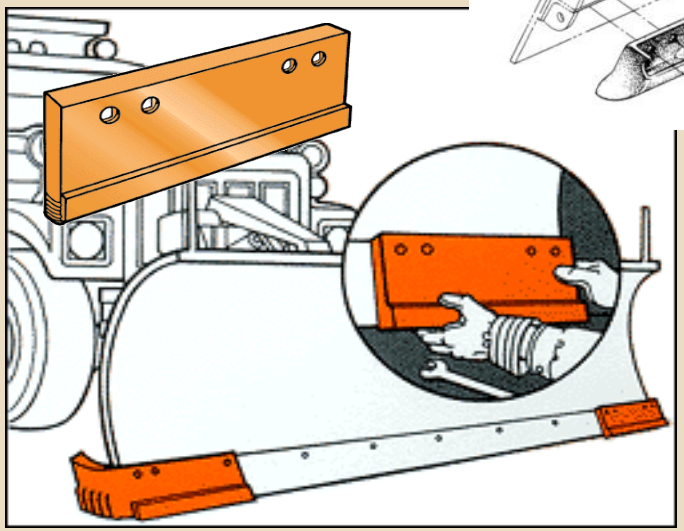
Snow and Ice Removal Plan

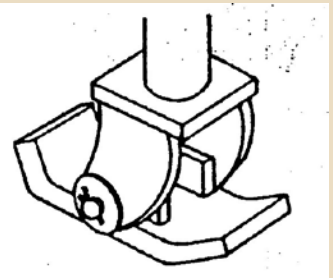
- Plow accessories
  - Shoes, skids, wheels, casters
  - Snow deflectors
  - Plow guards
  - Curb guards

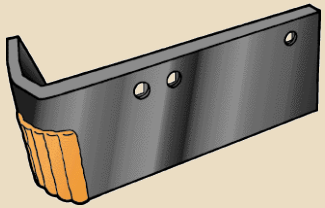


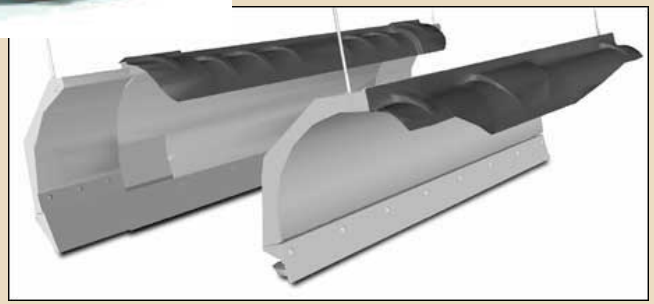












Snow and Ice Removal Plan

- Plow accessories
  - Plow markers
  - Wing extensions
  - Plow lights
  - Plow heaters

Safety - Lights

- Full check of all lights
  - Before/after every storm – see and be seen
  - Functioning correctly?
  - Clean? Unobstructed?
  - Focused/directed/pointed correctly?
  - Positioned correctly
    - For your use
    - So as to not unnecessarily blind oncoming drivers

  - Headlights, brake lights, turn signals
  - Strobes and beacons
  - Work lights (spinner, etc.)
  - Forward plow lights

Safety - Lights

- Selection of lights
  - Larger trucks – probably already outfitted well, particularly if a full plow and spreader purchased together [still, look closely]
  - Mid-size and pickup trucks – not always optimized for plowing and spreading
  - After-market strobes and beacons may not be powerful enough to be seen for the distances needed or under heavy fog or mist – try before you buy if you can
  - Get what you need
    - Let's not quibble over $200 in lights on a $120K rig

- Location of lights on the truck matter
  - Plow lights mounted too low may not clear the plow
  - Poorly directed work lights may be ineffective and cause glare or blindness

Safety - Lights

- LED vs. Halogen lights
  - Light-emitting diode (LED)
    - A two-lead semiconductor light source
    - A p–n junction diode, which emits light when activated
    - When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons
  - Halogen lamp
    - AKA, a tungsten halogen, quartz-halogen or quartz iodine lamp
    - An incandescent lamp that has a small amount of a halogen such as iodine or bromine added

Safety - Lights

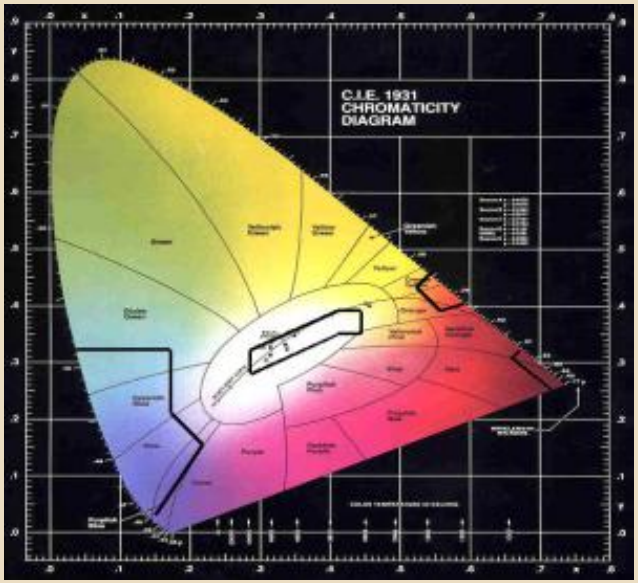
- LED vs. Halogen lights
  - LEDs use ~75% less energy than halogen
    - Less load on the vehicle electrical system
    - Frees up more energy for more lights
  - LEDs longer lifespan
  - LEDs brighter, crisper light
  - LEDs are generally costlier

Safety - Lights

- Society of Automotive Engineers – best practice standards
  - SAE J845 – "Minimum standards for omnidirectional (i.e., 360°) emergency warning lights"
    - Under J845 are 3 classes (Class 1 is brightest)
      - Light intensity is measured in candela-seconds/minute (cd-s/m)
    - Class 1 "Clearing Traffic" = 18,000 cd-s/m
      - This is generally what we want on our emergency equipment
    - Class 2 "Blocking Traffic" = 4,500 cd-s/m (25% of Class 1)
    - Class 3 "Identification only" = 1,800 cd-s/m (10% of Class 1)
      - This is what you want in a warehouse, where Class 1 or 2 might be detrimentally bright

Safety - Lights

- SAE – best practice standards (cont'd)
  - Lens color - J845 regulates colors using the 1931 International Commission on Illumination (CIE) color space chromaticity diagram (this will not be on the quiz)
    - Amber (right side)
    - White (center)
    - Red (lower right)
    - Blue (left)



    - The point?
      - A lighter shade of yellow may allow more light intensity but a rich, amber color is important also

Safety - Lights

- California Title XIII – a cautionary item
  - Some vendors make reference to California Title XIII, considered the toughest specification for light intensity
  - Like SAE's "classes", Title XIII uses "Tables"
    - For omnidirectional beacons, the proper table is Table 2
    - Some vendors will claim Table 4 compliance for LED beacon
      - But Table 4 is for strobe (gas discharge) lights, not LED
        - Table 4 is a much easier standard to meet
        - Table 2: 12,500 candela intensity required
        - Table 4: 125 candela intensity required
    - If a vendor touts Title XIII compliance but doesn't specify the Table number, press for details or move on
      - If they're going to bring up California Title XIII, they should be specific

Safety - Lights

- California Title XIII – a cautionary item (cont'd)

TABLE II. MINIMUM CANDELA FOR REVOLVING WARNING LAMPS

Test point coordinates				
Vertical	*Horizontal*	*Red*	*Yellow*	*Blue*
7.5U	V	50	130	25
5U	V	500	1,250	250
2.5U	V	3,000	7,500	1,500
H	V	5,000	12,500	2,500
2.5D	V	3,000	7,500	1,500
5D	V	500	1,250	250
7.5D	V	50	130	25

TABLE IV. MINIMUM CANDELA–SECONDS FOR GASEOUS DISCHARGE WARNING LAMPS

Test point coordinates				
Vertical	*Horizontal*	*Red*	*Yellow*	*Blue*
7.5U	V	5	12	3
5U	V	10	25	5
2.5U	V	30	75	15
	20L	5	12	3
	10L	12	30	6
	5L	33	82	17
H	V	50	125	25
	5R	33	82	17
	10R	12	30	6
	20R	5	12	3
2.5D	V	30	75	15
5D	V	10	25	5
7.5D	V	5	12	3

NOTE: The L and R test points do not apply to 360–deg lamps.

Safety - Lights

- Radio Frequency Interference (RFI)
  - RFI can cause interference with 2-way radios and other electronics
  - Since beacon lights are generally mounted near radio antennas, RFI specifications are important
    - RFI is a big problem with actual strobe tubes
    - Less so with LEDs, but still prevalent
  - CISPR25 is a specification for RFI
    - **C**omité **I**nternational **S**pécial des **P**erturbations **R**adio
    - CISPR25 Class 1 is the most permissive (allows the most RFI)
    - Class 5 is the toughest class (essentially zero RFI)
  - RFI specifications of Class 3, Class 4, or Class 5 recommended
  - Some vendors do not test for RFI

Safety - Lights

- Summary
  - SAE J845 Class 1 for light intensity
    - California Title XIII Table 2, if they are going to bring it up
  - CISPR25 Class 3 or better for RFI

Snow and Ice Removal Plan

- Snow melters
  - Rare to nonexistent here
  - Still…pretty cool

Stationary: 1200 tons per hour

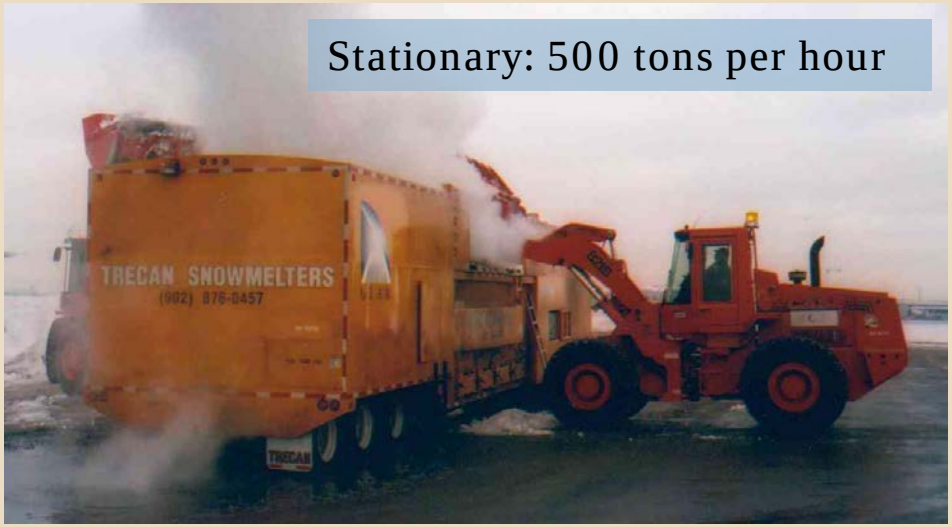
Stationary: 20 tons per hour


Stationary: 40 tons per hour

Snow and Ice Removal Plan

- Snow melters
  - Portables
  - Different sizes
  - High energy use
  - Control discharge water

Stationary: 20 tons per hour



Stationary: 500 tons per hour


Stationary: 40 tons per hour

Snow and Ice Removal Plan

- Material spreaders
  - V-box
  - Tailgate
  - Tow behind
  - Dual dump
  - Zero velocity

Snow and Ice Removal Plan

- V-box spreaders
  - Steep slides minimize material hang-up
  - Restricts truck use during winter operations

Snow and Ice Removal Plan

- Tailgate spreaders

Snow and Ice Removal Plan

- Tow behind spreaders

Snow and Ice Removal Plan

- Dual dump spreaders
  - This approach provides truck traction
  - Chute approach drops material at crown; as brine forms, material moves across road

Snow and Ice Removal Plan

- Zero velocity spreaders

Snow and Ice Removal Plan

- Spreader alternatives

Video

Snow and Ice Removal Plan

- Spreader controls
  - Manual
  - Computer operated
  - Automatic

Snow and Ice Removal Plan

Equipment	Light Snow	Moderate Snow	Severe Snow	Moderate Ice	Severe Ice
Tri-axle Truck/Plow/ Spreader			C		C
1-Ton Dump/Plow/Spreader	O	O	O, C	O	O, C
½-Ton Pickup/Plow	O, B	O	O, C	O	O
Loader	O, B	O, B	O, C	O	O, C
Skid Steer/Broom	O, B	O	O, R	O	O
Mower/Plow/Broom	O	O	O	O	O
Motor Grader			C, R		
Loader-mounted Snow Thrower			C		
Welder		R	R	R	R
Key: O – Own; C – Contracted; B – Borrow; R – Rent					

Snow and Ice Removal Plan

- GPS
  - May already have it on some of your equipment
  - Can tell you a lot about where your equipment is, has been
  - Can reduce communications traffic
  - Can help you move resources – you may be able to see in real time on a screen where they are relative to a problem area
  - Can aid with performance measures
  - Can refute erroneous accusations from the public

Snow and Ice Removal Plan

- Equipment maintenance
  - In-house maintenance garage
    - Dedicated mechanics
  - Ad hoc in-house maintenance
    - Dilution of snow fighting resources?
  - Private sector mechanics
    - Will they be open on-demand?

Snow and Ice Removal Plan

- Equipment washing
  - Need to wash equipment
    - Minimize corrosion
    - Improve operating efficiency
    - Extend useful life
  - Salt, sand, oils, greases on equipment is considered a pollutant
  - Hosing it down in the equipment yard releases those pollutants to the environment
  - DNREC says “nay, hay”
  - Equipment wash bay
  - Commercial equipment washing facilities
  - Wastewater collected, recycled, treated

Snow and Ice Removal Plan

- Towing and recovering equipment
  - Contract with local tow company
  - In-house wrecker
  - Tow chains, winches, etc.
  - Safety
    - Chains, cables, tow straps, winches – dangerous
    - Slips, flying cables/chains
    - Pinch points for hand and body
    - No time for rushing around
    - No place for cowboys
    - Do it right and everybody comes back with ten fingers

Snow and Ice Removal Plan

- Fueling locations
  - Your own tanks/pumps
  - Other agency tanks/pumps
  - Commercial fueling stations
  - Reliably available in emergency situations?
- Power outage contingencies
  - Ice storms particularly dicey for power outages
  - Communications concern
  - Heating concern at facilities
  - Lighting for yard operations
  - As threat rises, fill all your tanks to minimize your exposure

Snow and Ice Removal Plan

- Equipment storage
  - Diesel engines
    - Block heaters
    - Enclosed garages
    - Heated garages
  - Off-season storage of plows, spreaders, brooms
    - Protection – rust, corrosion, physical damage, clogged/damaged hoses
    - Security (theft)
  - In-season location of plows, spreaders, brooms
    - Quick connection
    - Security (theft)
    - Protection –corrosion, physical damage, clogged/damaged hoses

Snow and Ice Removal Plan

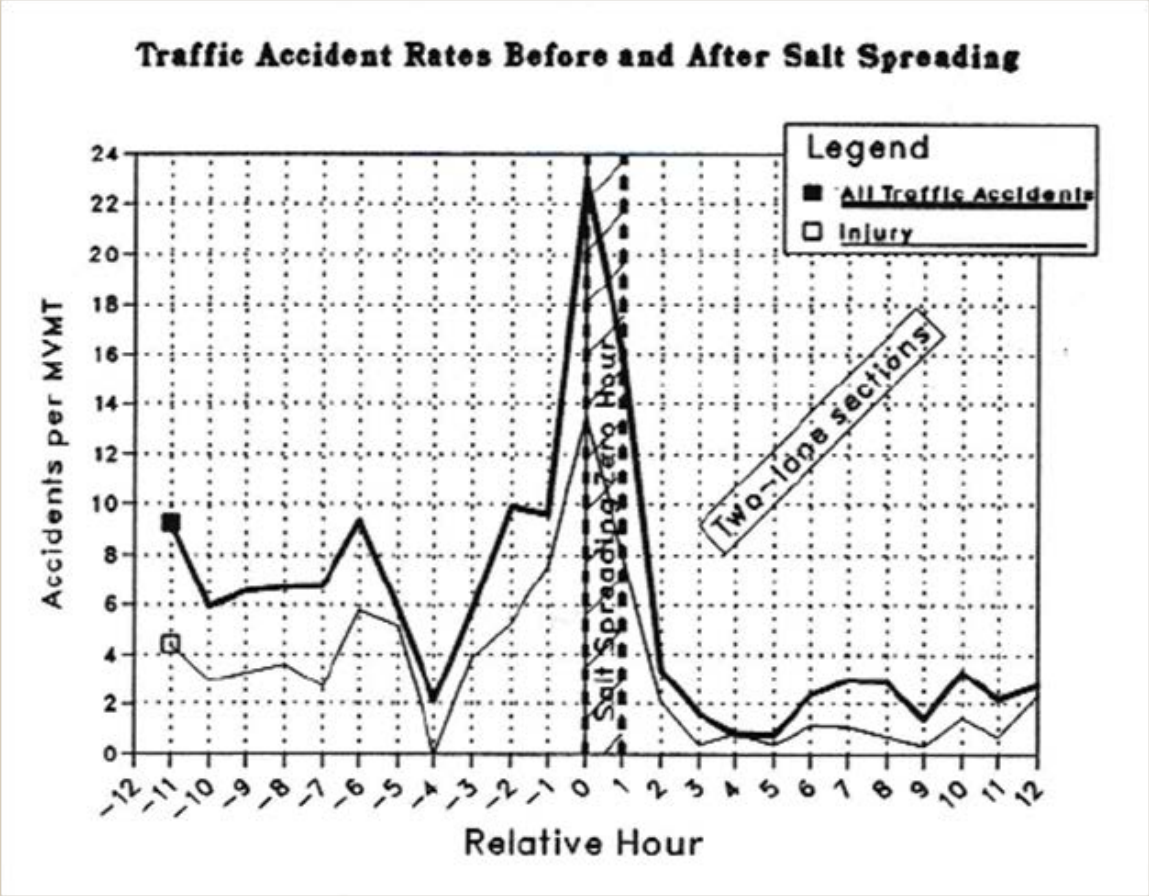
- Material storage
  - Site considerations
    - Vicinity to the work
    - Size, maneuverability, ingress/egress
  - Storage type
    - Barn, silo, igloo, covered stockpile
    - Impervious floor/pad, protected from precipitation
  - Material capacity
    - 100% average annual usage – desired
  - Abrasives treatment
    - Typically 3-5% salt blended

Snow and Ice Removal Plan

- Freeze point depressants
  - Rock salt (NaCl)
  - Calcium magnesium acetate (CMA)
  - Magnesium chloride (MgCl)
  - Calcium chloride (CaCl)
  - Potassium acetate (KA)
  - Magic Salt
- Abrasives
  - Sand
  - Sand/salt mixtures

Snow and Ice Removal Plan

- Safety effect of chemicals



Snow and Ice Removal Plan

- Salt
  - Specifications
    - Standards
    - Gradation
    - Moisture
    - Anti-caking agents
  - Advantages
  - Deicing / anti-icing
  - Prewetting
  - Equipment
  - Storage & handling
  - Environmental safety

Snow and Ice Removal Plan

- Other chemicals
  - Calcium chloride
  - Magnesium chloride
  - Natural or processed brines
  - CMA (calcium magnesium acetate)
  - Other proprietary materials

Snow and Ice Removal Plan

- Recap – common road treatment materials

Chemicals

- Salt (Sodium chloride)
- Calcium Chloride
- Magnesium Chloride
- Potassium Chloride

Natural Occurring Salts

- Brines (by-product of gas production)
- Potassium Acetate
- Calcium Magnesium Acetate
- Urea
- Agricultural By-products
- Other Proprietary Materials
- Abrasives

Snow and Ice Removal Plan

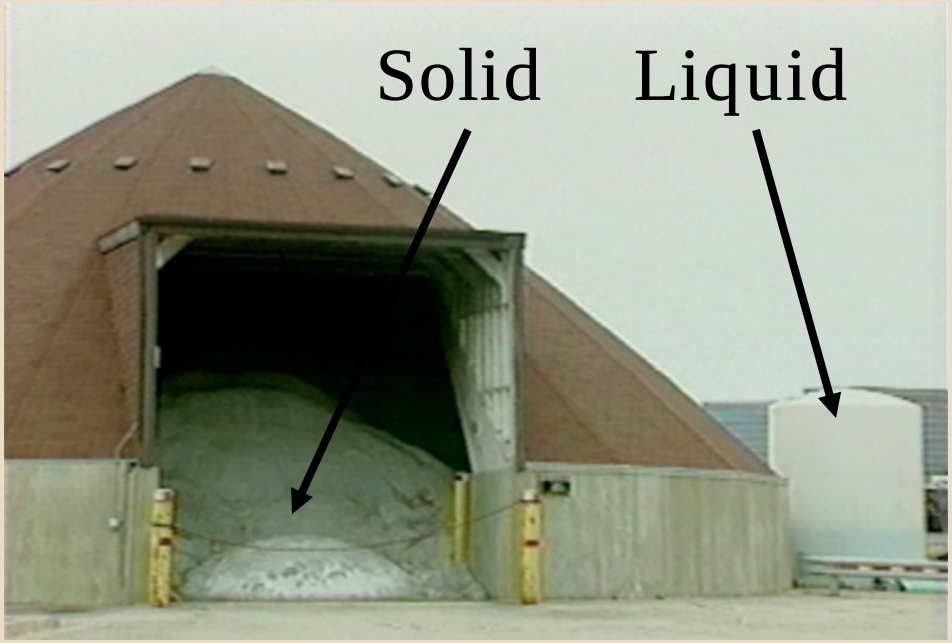
- Chemicals
  - Specifications
  - Material Safety Data Sheet (MSDS)
  - Talk to other users
    - Effectiveness
    - Concerns
    - Problems

Snow and Ice Removal Plan

- Chemical application techniques
  - Deicing
    - Tradition, reactive – applied after ice forms
  - Anti-icing
    - Proactive – applied before storm to minimize bond forming
  - Pre-wetting
    - Creating a 'brine starter kit' by wetting the salt in the truck bed or as it is spun onto the roadway – accelerates the formation of the ideal brine
  - ...more on these in Module 4...

Snow and Ice Removal Plan

- Material Storage
  - Proper storage of materials is essential - specifically chemical storage
  - Sufficient capacity and proper containment or cover are necessary



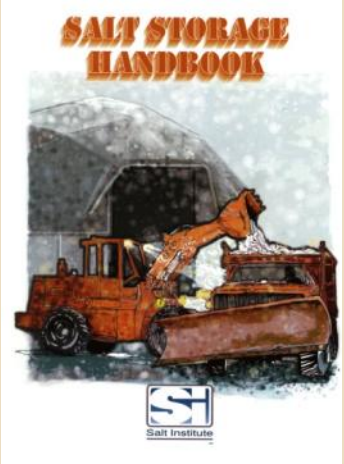
Snow and Ice Removal Plan

- Major points of good salt storage
  - Sufficient capacity
  - Inside storage, if possible
  - Outside piles properly shaped & covered
  - Impermeable pads
  - Proper drainage with containment as required
  - Good housekeeping
  - Structurally sound

Snow and Ice Removal Plan

Snow and Ice Removal Plan

- Salt Institute's "S.A.L.T.E.D. principles
  - A sort of "best practices" for material storage facilities



ClearSpan Follows S.A.L.T.E.D.

The Salt Institute recommends that salt be stored in a roofed enclosure in order to provide the most economical and environmentally safe solution. Here is how ClearSpan Hercules Truss Arch Buildings match up to their recommendations.

S.A.L.T.E.D.	Salt Institute's Storage Site Suggestions	ClearSpan Features
Safety	▪ Good visibility for operators ▪ No direct access to heavily traveled roads ▪ Warning signs at entrances ▪ Security fencing ▪ Safety for the surrounding environment	▪ Sturdy, long-lasting buildings ▪ Made with American-made steel ▪ Warranty: 15 years ▪ Great visibility due to the natural light the fabric lets inside ▪ No echoes to confuse or disrupt work flow
Accessibility	▪ Easy access for equipment and delivery ▪ Big enough for front-end loaders ▪ Room for a 20-foot extension ▪ Doors large enough to accommodate equipment	▪ Structures can be left open ended ▪ Doors that are large enough for vehicle clearance can be added ▪ Can build a pony wall to increase structure's height/sidewall clearance
Legality	▪ Comply with local zoning ordinances ▪ Required discharge permits	▪ Engineered, stamped drawings ▪ Follow wind and snow load regulations ▪ Building permits may not be required
Tidiness	▪ Make buildings as attractive as possible ▪ Keep buildings well maintained ▪ Good housekeeping around the storage site ▪ Screening the storage site with fencing	▪ Can be customized with different colors ▪ No shadows ▪ Can add dividers inside building ▪ Can also store vehicles and other needed equipment
Economics	▪ Permanent covered storage ▪ Locate storage site to avoid long-distance hauling	▪ Can be moved, if necessary ▪ Covered enclosure prevents salt loss ▪ Allows greater storage capabilities ▪ Energy efficient, environmentally safe
Drainage	▪ Good drainage away from the stockpile ▪ Sloping bituminous pads containing runoff ▪ Installing retention curbs ▪ Disposing salt brine in conformance with applicable federal and state regulations and local ordinances	▪ Any type of drainage can be added or built within structure, if desired ▪ Can install retention curbs ▪ Ventilation options available, if needed

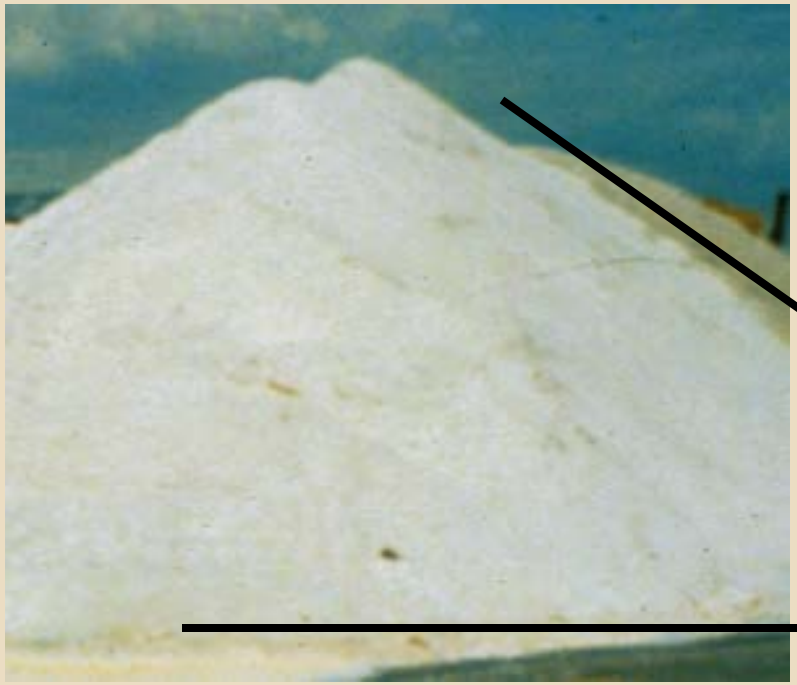
Snow and Ice Removal Plan

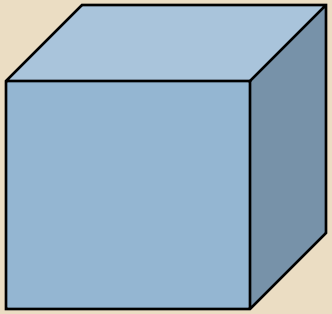
Improper storage can only lead to problems!

Snow and Ice Removal Plan

- Open faced storage should include covering of the material face to isolate it from the elements

Snow and Ice Removal Plan





1 cubic foot salt = 80 pounds

or 1 cu. yd. = 2160 lbs.

32º

Angle of Repose

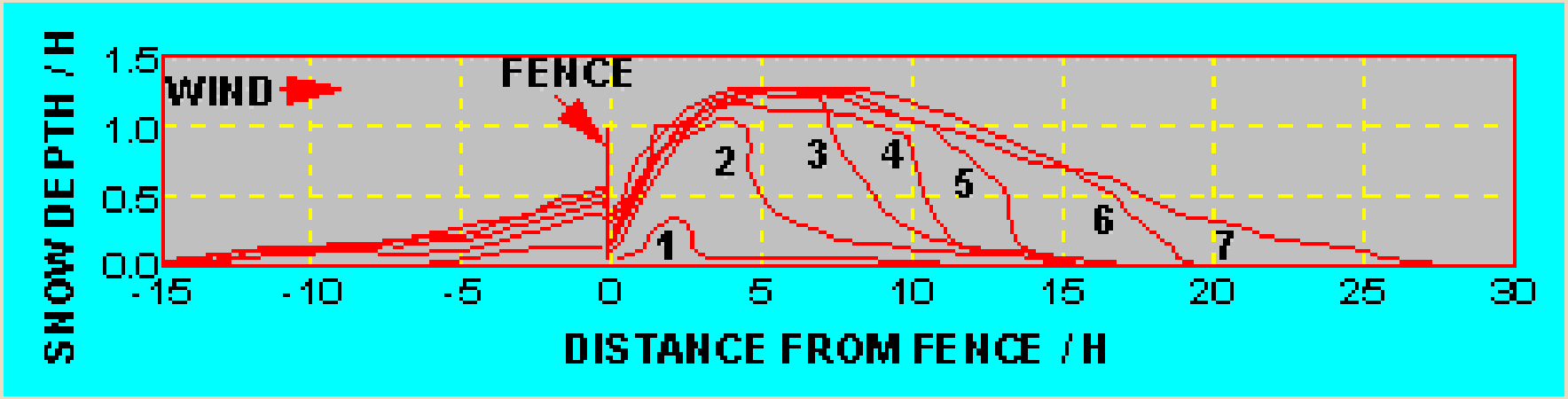
1 ton of salt requires 25 cubic feet of storage

Snow and Ice Removal Plan

- Snow fence
  - Not used as much in Mid-Atlantic
  - Theory
    - Cause snow to drift downwind of the fence
    - Cause an eddy to form behind the fence
    - Velocity differentials cause snow to drop in place
  - Labor and material intensive
  - Use where drifting can cause serious problems
  - Vegetation (line of spruce trees, etc.) can be an effective, natural snow fence
    - Attempt to work together with adjoining property owner for mutual benefit

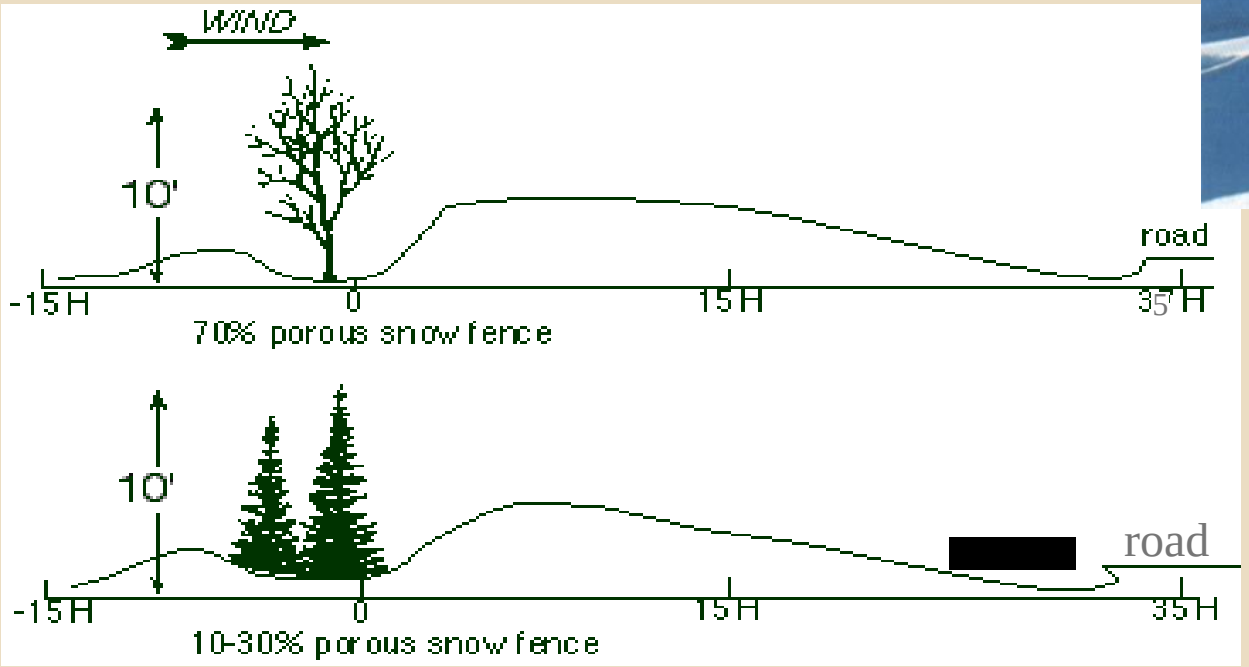
Snow and Ice Removal Plan

- Snow fence
  - Snow Drift: Max height at 6H equal to 1.5H, max length 35H (H = fence height)



Snow and Ice Removal Plan

- Living snow fence



Snow and Ice Removal Plan

- Voice and data systems
  - Telephones – you know, land lines
  - Cellular phones, text, emails – but not while driving!
  - Equipment radios
  - GPS
    - Fleet tracking
    - Mobile weather monitoring
    - Plow and material usage
  - Weather stations/monitoring
  - Performance analysis/reporting

Snow and Ice Removal Plan

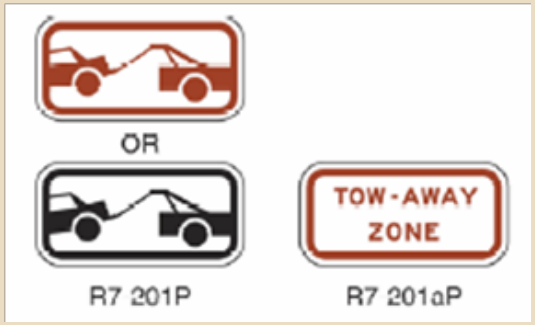
- Communications
  - Internal communications (intra-agency)
    - Crew level
    - Agency wide
  - Semi-internal communications (inter-agency)
    - Informal relationships
    - Mutual aid agreements
  - Senior management and elected officials
  - Public
    - Get out ahead of the frustrations - engage
  - The media
  - Who else?

Snow and Ice Removal Plan

- Chain of command
  - There really must be someone in operational control during events
  - Incident Command approach
  - All due respect, elected officials and senior management need to step back at that point and entrust the operation to the command structure
  - Flexibility? Yes, but…
  - Procedures, rules, limits must be respected
  - No room for cowboys or rogue operations
  - Everyone should know who is in charge of what

Snow and Ice Removal Plan

- Snow emergency routes
  - Delaware Manual on Uniform Traffic Control Devices (MUTCD), Section 2B-46
  - Consistent, correct signage = better enforceability



Snow and Ice Removal Plan

- Route planning
  - Route maps
    - Priority routes versus secondary versus…
    - Streets
    - Parking lots
    - Pedestrian pathways
  - Crew assignments
  - Equipment assignments
  - Contingencies

WINTER STORM OPERATIONS
SNOW PLOWING
KUBOTA UTILITY TRUCK # 901

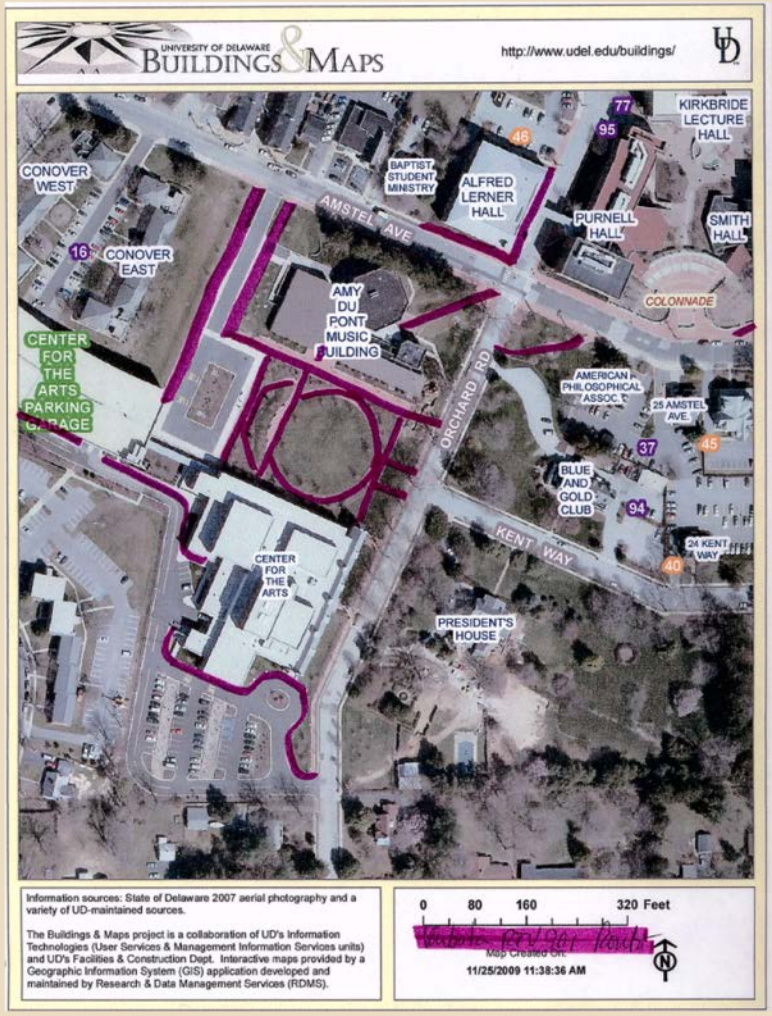
2009-2010

DURING STORM PUSH PATHS IN THESE AREAS

1. Admissions Building:
   - Plaza area on North side of building
   - Sidewalks from S. College Ave. into the parking lot
   - Sidewalks from entrance of building on north side to parking lot
   - Sidewalks along S. College Ave. north to Kent Way
2. Smith Hall Bridge ramp from end of bridge to Amstel Ave. (LIFT PLOW AT EXPANSION JOINT)
3. Sidewalk from Amstel Ave. to Orchard Road
4. Center for the Arts Building:
   - Sidewalk from Amstel Ave to parking garage entrance
   - Sidewalk from parking garage underneath colonnade to start of building
   - Sidewalk from building past flagpoles to Amy DuPont Music Building and north to Amstel Ave
   - Sidewalks between Amy DuPont and CFA and around great lawn area
   - South side entrance of Amy DuPont Music Bldg.
   - Sidewalks on south side of CFA at circle
   - Sidewalks on west side of CFA at service entrances
5. Amy DuPont Music Building main sidewalk from doors to Orchard Rd.
6. Alfred Learner Hall sidewalks:
   - Amstel Ave. sidewalk
   - Orchard Rd, sidewalk from Amstel Ave. to Delaware Ave.
7. Start again at # 1 when this point is reached when this point is reached until doing last pass completely when storm is over.
8. Clean-up all sidewalks, plazas, and/or fire lanes throughout the entire route.
9. Assist other areas as directed when this point is reached on list and/or as directed by manager.

AFTER STORM IS OVER PUSH THE ABOVE AREAS OFF COMPLETELY TO THEIR EDGES

Snow and Ice Removal Plan



Snow and Ice Removal Plan

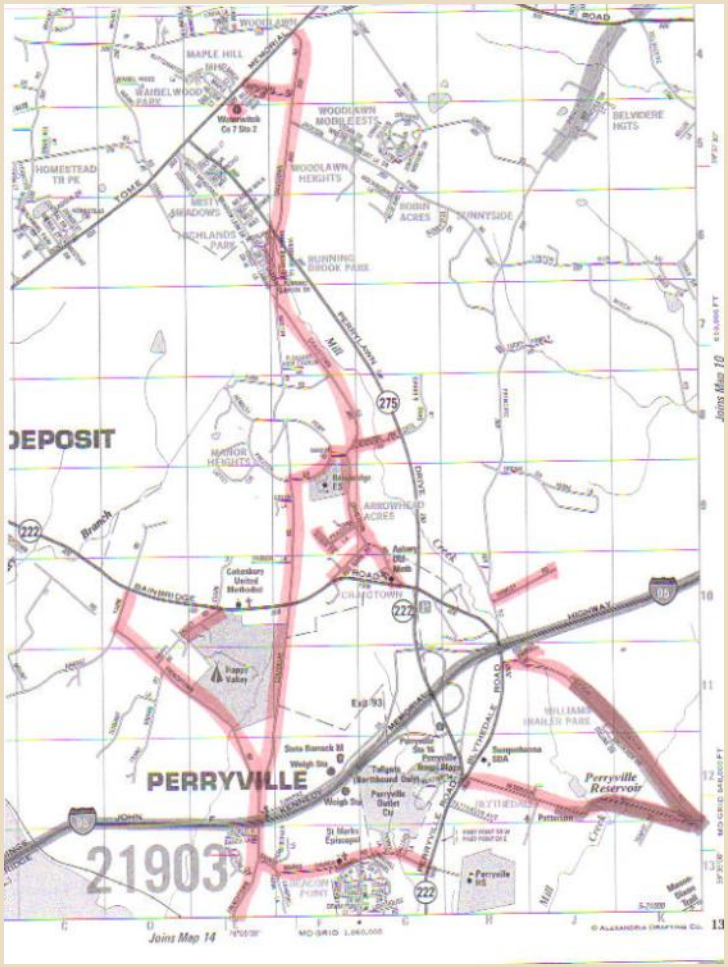
SNOW ROUTE		
GEORGE LOMAS TRUCK #990 PLOW & SPREADER		
AREA 3-1		
ABRAHAMS ROAD		0.23
CRAIGTOWN ROAD		2.58
BARTON ROAD		0.35
PLEASANT VIEW CHURCH ROAD		0.08
FUNK ROAD		0.43
DIAMOND JIM ROAD		0.30
RED BARN ROAD		0.24
MANOR ROAD		0.07
PRESTON DRIVE		0.53
COKESBURY ROAD		1.69
FRENCHTOWN ROAD		2.33
ST MARKS CHURCH ROAD		0.70
MT ARARAT FARM ROAD	MD RTE 222 TO FRENCHTOWN	0.18
HAPPY VALLEY ROAD	OFF MD RTE 222	0.37
LEBRUN ROAD		0.06
JACKSON STATION		2.03
RESERVOIR ROAD		1.07
OLD HAWLEY ROAD TO BRIDGE		0.04
HAWLEY ROAD		0.35
GONCE ROAD		0.20
HOLLY TREE LANE		0.16
COUDON BLVD		0.55
CEDAR CORNER		0.28
MILL CREEK ROAD		0.51
GILLEY ROAD		0.12
PRINCIPIO STATION		0.32
PATTERSON AVENUE		0.20
PEACOCK LANE	OFF CRAIGTOWN RD	0.12
ROBIN DRIVE	OFF CRAIGTOWN RD	0.12
	TOTAL MILEAGE	16.21
FIRE STATIONS		
STATION 72 - ABRAHAMS ROAD	PORT DEPOSIT,MD	
STATION 6 - 920 PRINCIPIO FURNACE ROAD	PERRYVILLE, MD	
STATION 16 - 16 JR DAWSON DRIVE	PERRYVILLE, MD	
SECONDARY ROUTE		
BELVIDERE ROAD		2.46
PRINCIPIO ROAD	THEODORE RD TO BLYTHEDALE RD	2.95
FAIRVIEW DRIVE		0.06
WINCHESTER COURT		0.19
	TOTAL MILEAGE	5.66

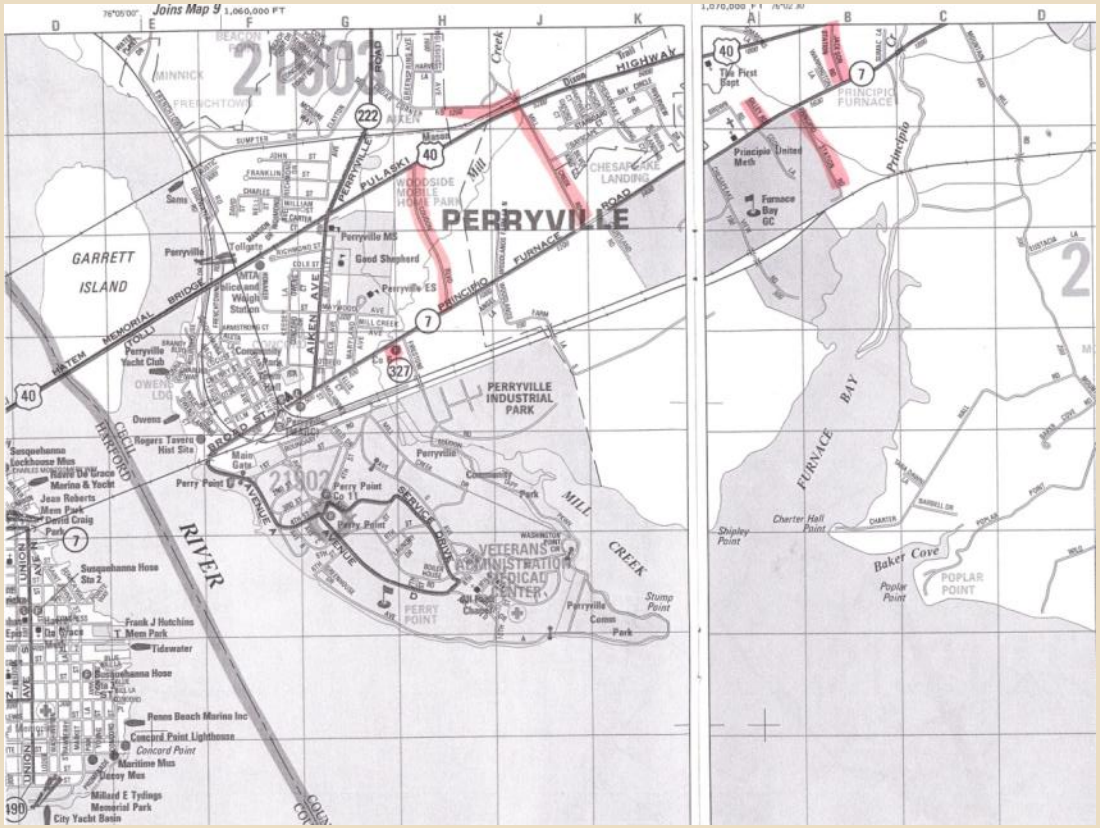
SNOW ROUTE ASSIGNMENTS
2010-2011
NORTHERN AREA

AREA	DRIVER / CONTRACTOR	TRUCK
3-1	George Lomas	990 COUNTY TRUCK PLOW & SPREADER
3-2	Richard Bittner	992 COUNTY TRUCK PLOW & SPREADER
3-3	Mike Cox	989 COUNTY TRUCK PLOW & SPREADER
3-3A	Robert Peoples	977 COUNTY TRUCK PLOW
3-4	Josh Hoderfield	979 COUNTY TRUCK PLOW & SPREADER
3-5	Mark reeder	910 COUNTY TRUCK PLOW AND V-BOX
3-6	Mike's Lawn	ONE TON PLOW AND SPREADER
3-7	Mike Madron	991 COUNTY ONE TON PLOW & SPREADER
3-7A	Riverview	PICK UP TRUCK PLOW ONLY
3-8	Sammy Craig	980 COUNTY TRUCK PLOW & SPREADER
3-9	Riverview	ONE TON WITH V-BOX
3-10	Russell trucking	TRI AXLE PLOW AND SPREADER
3-11	Phil's Lawncare	ONE TON PLOW AND SPREADER
3-12	Al Sallsbury	COUNTY PICK UP WITH PLOW

Contractor	Phone Number
RUSSELL TRUCKING	
MIKES LAWN SERVICE	
PHIL'S LAWNCARE	
RIVERVIEW	

Snow and Ice Removal Plan





Case Study in Snow Routes

BY LAWRENCE WALSH, JAMES POWELL, XIAOLUN GUO

UNDER THE SUPERVISION OF JASON WINTERLING

JUNE 2016

Speeds

- Level I routes driven at 5 mph below speed limit
- Level III routes driven at 15 mph on main roads and 10 mph on residential streets

Route Times

- Route 1
  - Level I: 28 minutes
  - Level III: 2 hours 13 minutes
- Route 2
  - Level I: 35 minutes
  - Level III: 2 hour 51 minutes
- Route 3
  - Level I: 36 minutes
  - Level III: 1 hour 21 minutes
- Route 4
  - Level I: 43 minutes
  - Level III: 1 hour 32 minutes
- Route 5
  - Level I: 35 minutes
  - Level III: 3 hours 15 minutes
- Route 6
  - Level I: 1 hour 5 minutes
  - Level III: 2 hours 30 minutes

Route Change Suggestions – Level III

1. Switch developments connected to Church Road from Route 5 to Route 3
2. Switch developments southeast of the train tracks from Route 5 to Route 4
3. Switch Woodlawn Ave development from Route 1 to Route 6

Current and Proposed Route Times

	Route 1	Route 2	Route 3	Route 4	Route 5	Route 6
Current	2:13	2:51	1:21	1:32	3:15	2:30
Combined Suggestions	1:50	2:51	2:00	2:00	2:20	2:50
Change	-17%	Unch	+48%	+30%	-28%	+13%

Total time – 13 hours 42 minutes to 13 hours 51 minutes

Adoption

- The Snow and Ice Plan is written
- Now what?
- Adopt it
  - Publish it – newspaper, website, radio announcements
  - Stakeholder review
  - Public hearing/meeting
  - Adoption by local elected body

- Actually follow the plan
- Keep records of performance and usage
- Review and update it each year – each <u>spring or summer</u>

Standard Operating Procedures

- These may already be written – reference them
- Otherwise, write them
- Examples
  - Reporting for duty
  - Plowing and salting procedures
  - Safety procedures
  - Public and press relations
  - Dealing with abandoned/incapacitated vehicles

Budgeting

- The Snow and Ice Removal Plan tells you your needs:
  - Manpower
  - Equipment
  - Materials
  - Contractors
  - Facilities
  - Other support

- Your budget proposal should reflect those needs; no more, no less

Implementation

- Recordkeeping
  - Why?
    - Anticipation of reimbursement (declared emergencies)
    - Performance reporting
    - Revision of plan
    - Support program development, evolution, and resource needs
    - Defense against claims (tort and others)

Implementation

- Recordkeeping
  - Types
    - Preparation
    - Event
    - Manpower
    - Equipment
    - Materials
    - Contractors
    - Rentals
    - Maintenance/repairs

You're Ready

- Your Snow and Ice Removal Plan is in place
- You're properly budgeted for it
- You're ready to implement it

- Time to talk about pre-season activities – Module 3

Need More?

Matt Carter

Municipal Engineering Circuit Rider

Delaware T^2 Center

matheu@udel.edu

(302) 831-7236

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