

# **Innovations in Snow and Ice Management**

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## **Winter Maintenance Decision Support Systems and Snow Model Analysis**

**Jay N. Meegoda, Ph. D., P.E.**

**Department of Civil & Environmental Engineering  
New Jersey Institute of Technology,  
Newark, NJ 07102**

**and**

**Member, Board of Trustees,  
Passaic River Coalition  
Morristown, New Jersey 07960**

# Snow, Ice and De-icing

- **New Jersey Department of Transportation allows 5cm (2") of snow accumulation without treatment if the pavement temperature is above freezing.**
- **Ice forms with snow and the pavement temperature (not air temperature) below freezing at 0°C (32°F).**
- **De-icing material is used to lower the pavement temperature to prevent ice formation.**
- **Salt (NaCl) is the most cost effective de-icing material. The effectiveness of de-icing by salt rapidly decreases with decrease in pavement temperature and becomes totally ineffective when the pavement temperature is below -21°C (-6°F). Below 20°F salt should not be used.**
- **Salt is the most damaging de-icing material that cause degradation of concrete, corrosion of steel and ground water contamination.**

# Innovations in Snow and Ice Management

- New technologies and innovations to reduce the usage of salt:

- Road Weather Information System (RWIS)
- Anti-Icing
- Maintenance Decision Support Systems (MDSS)
- Snow Models



# Road Weather Information System (RWIS)

- Provide safer highways
- Improve road maintenance decision making
- Improve traveler information
- Provide data for review of historical weather events to enhance transportation planning

# Types of Data Collected

- Air temperature
- Wind speed and direction
- Chemical presence in roadway
- Humidity
- Pavement temperature
- Precipitation: amount, rate and type
- Other?

# Pavement Sensors



- Pavement temperature
- Frost depth
- Chemical concentration
- Traffic information

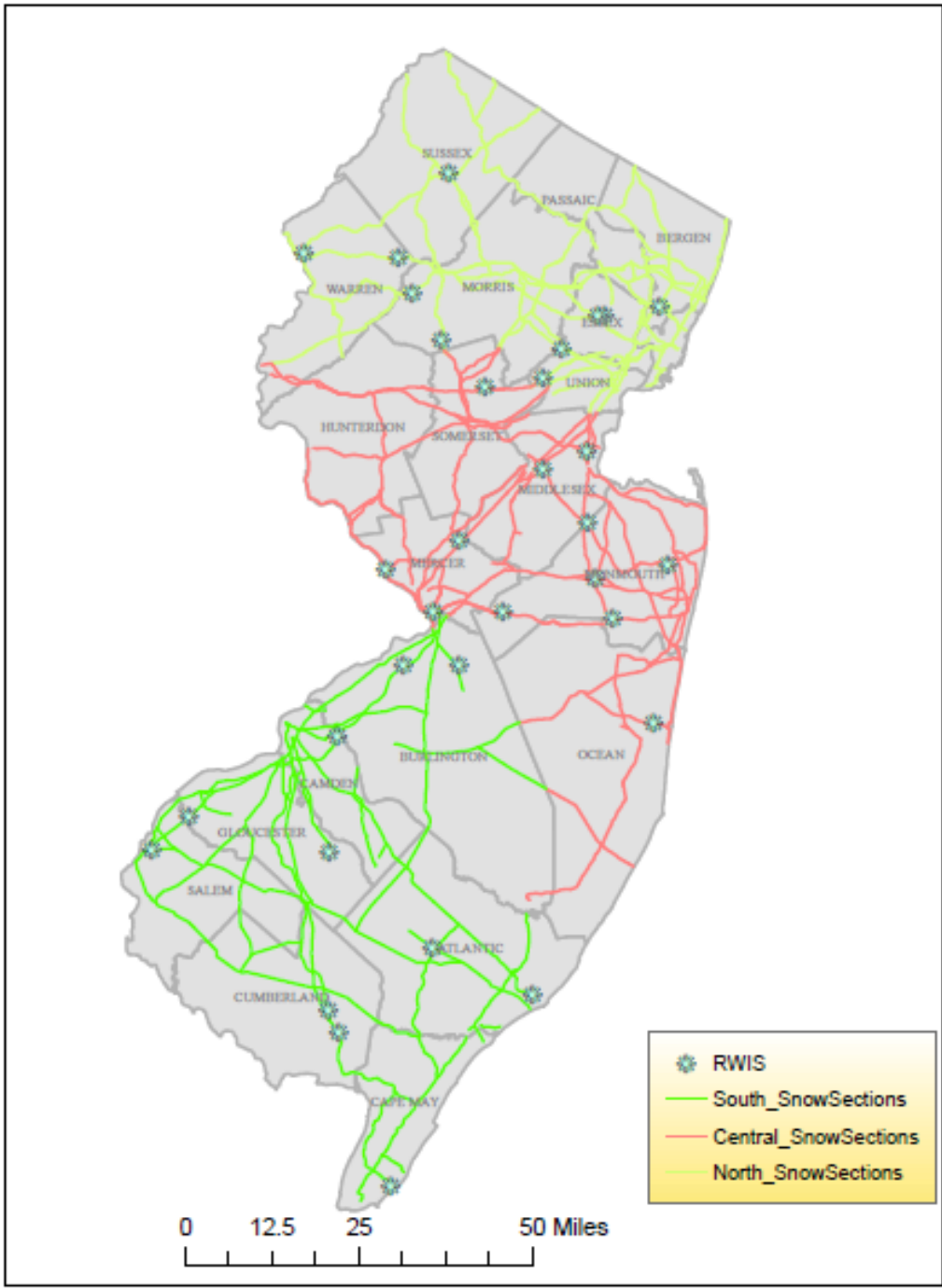
# Atmospheric Sensors

- Wind speed and direction
- Precipitation
- Barometric pressure



# Pavement Temperature

- Pavement temperature will determine if the snow will turn into ice, which is a road hazard.
- Hence the pavement temperature sensor is the single most important parameter in all the recent innovations of ice and snow management.
- Pavement temperature is obtained from pavement sensors or from vehicle-mounted infrared sensors on and data transmitted from Wi-Fi networks.



# Anti Icing Versus Deicing

- Anti-icing is designed to prevent the formation of ice, while deicing is designed to remove ice once it has formed.
- Anti-icing is a pro-active approach to winter road maintenance. Anti-icing forms a bond-breaker between the pavement surface and the snow and ice layer which melts snow more quickly and reduces the chance that ice will form and bond to the surface.

## A DEICING CHEMICAL SAMPLER MENU

**Salt:** The cheapest option. Effective until 20°F or below. \$30/Ton\*

**Brine:** Mixture of salt and water applied in advance of snow.

**Pre-wetted Salt:** Reduces salt use by eliminating bouncing off the road.

**Calcium Chloride:** Used below 20°F. Often combined with salt. \$91/Ton\*

**Magnesium Chloride:** Often used with sugar beet/cane molasses additives to reduce its corrosive effects and help adhesion. \$46-\$100/Ton

**Potassium Acetate:** Low corrosion, environmentally friendly. \$601/Ton\*

**Calcium magnesium Acetate:** “safe” as tap water. \$1000/Ton\*

\*2001 prices as estimated by Colorado Dept. of Transportation



# Anti Icing Systems



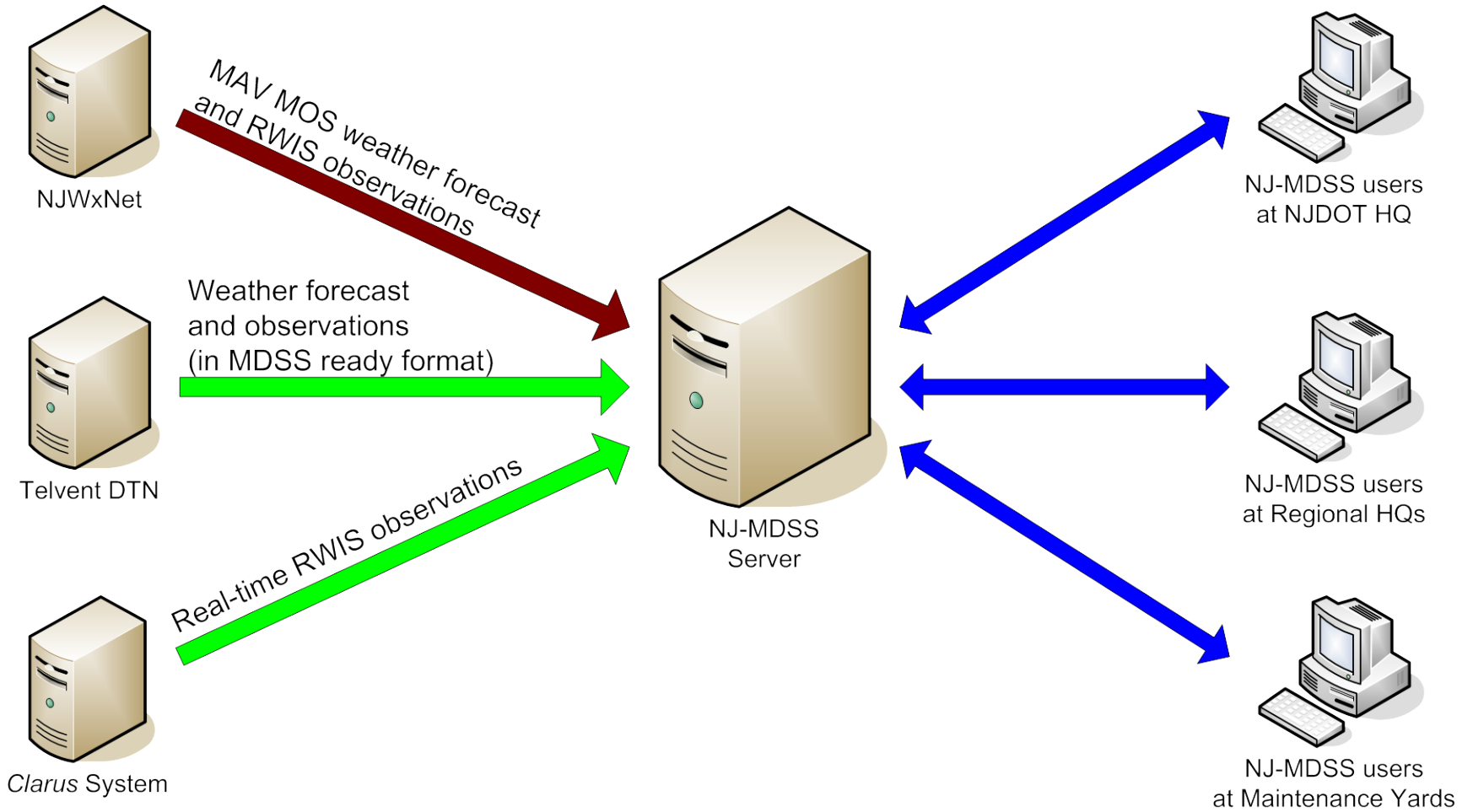
# The Need for a NJ Maintenance Decision Support System (MDSS)

- The highway maintenance managers currently use newspapers, Weather Channel, USA Today, NWS, and private meteorologists to make decisions.
- Road weather information systems are not integrated with road management systems.
- Hence the winter road maintenance decision process is generally reactive in nature.

# Maintenance Decision Support Systems (MDSS)

- Provide display capability for the condition of the roadway.
- Develop a decision support tool that provides recommendations on road maintenance courses of action together with anticipated consequences of action or inaction.
- Provide all the above on a single platform.

# NJ-MDSS Data Flow



**Selected Maintenance Area:**

New Jersey

**New Jersey Alerts:**

	0-12 Hrs	12-24 Hrs	24-48 Hrs
Weather			
Road			
Blowing SN			
Bridge Frost			

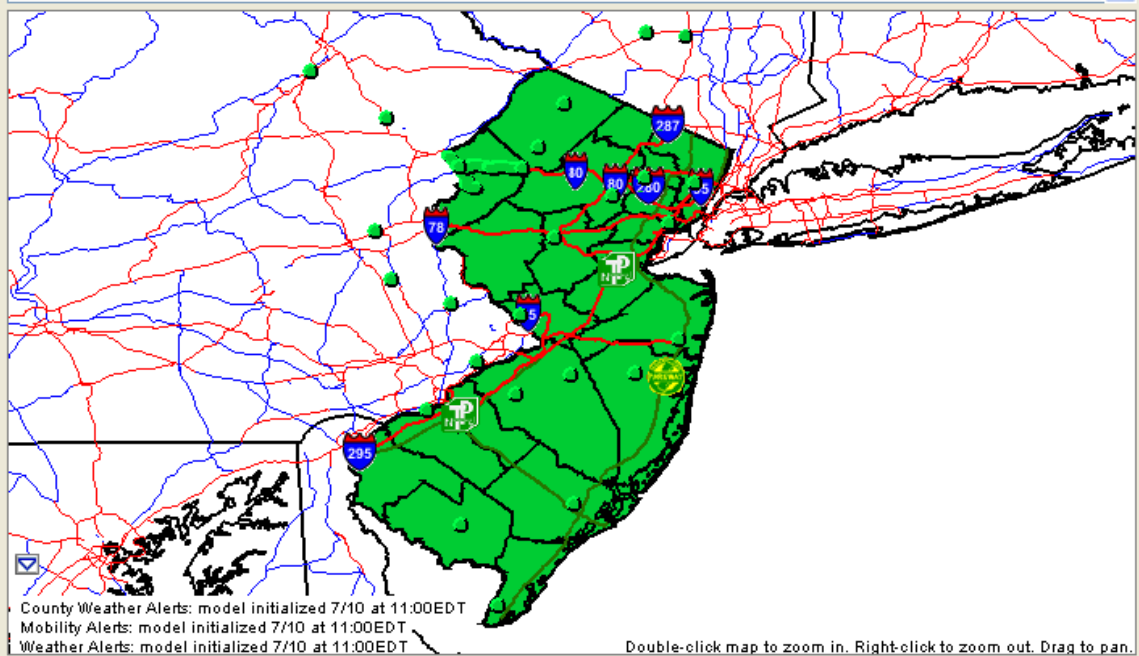
  

11 Sun 7/10	23	11 Mon 7/11	23	11 Tue 7/12
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No Frozen Precipitation Observed      Road(s) > 32°F

**Map Products:**

- Weather Forecasts: Weather Alerts
- Road Forecasts: Mobility Alerts
- Point Observations: None
- Area Observations: None
- Overlays: Click to select...

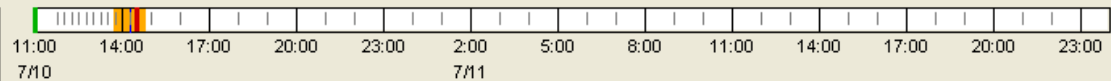


**Selected Plow Route:**

Select a route...

**Selected Time and Animation:**

- Observations Only
  - Forecast Only
  - Observations and Forecast
- 



**Selected Maintenance Area:**

Columbia Yard

**Columbia Yard Alerts:**

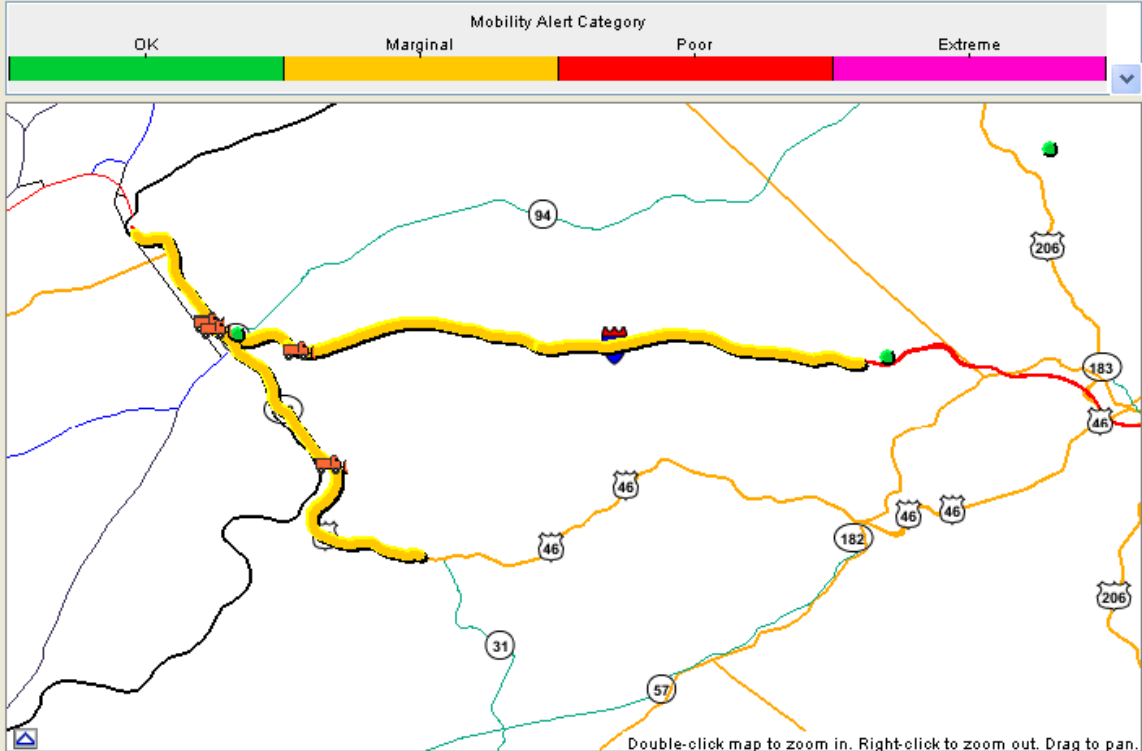
	0-12 Hrs	12-24 Hrs	24-48 Hrs
Weather			
Road			
Blowing SN			
Bridge Frost			

	11 Tue 4/12	23	11 Wed 4/13	23	11 Thu 4/14
No Frozen Precipitation Observed					
Road(s) > 32°F					

**Map Products:**

- Weather Forecasts:
- Road Forecasts:
- Point Observations:
- Area Observations:
- Overlays:



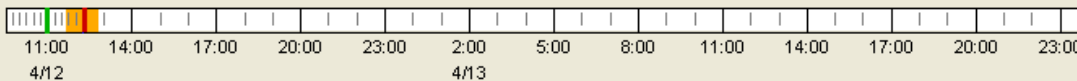
**Selected Plow Route:**

Select a route...

**Selected Time and Animation:**

- Observations Only
- Forecast Only
- Observations and Forecast

GO

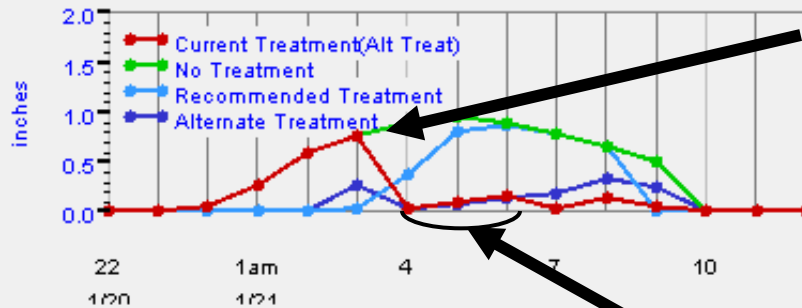


# INTERSTATE 80 MP 12-19.9

## Displayed Result:

- Mobility
- Snow Depth on Road
- Road Surface Temperature
- Chemical Concentration

## Snow Depth on Road



Snow accumulation on road surface would reach 0.8 inches with recommended treatment by NJ-MDSS

## Treatments:

### Current Treatment Plan



Salt was not very effective during this time period, thus NJ-MDSS did not recommend spreading

### No Treatment

### Recommended Treatment



### Alternate Treatment

Enter



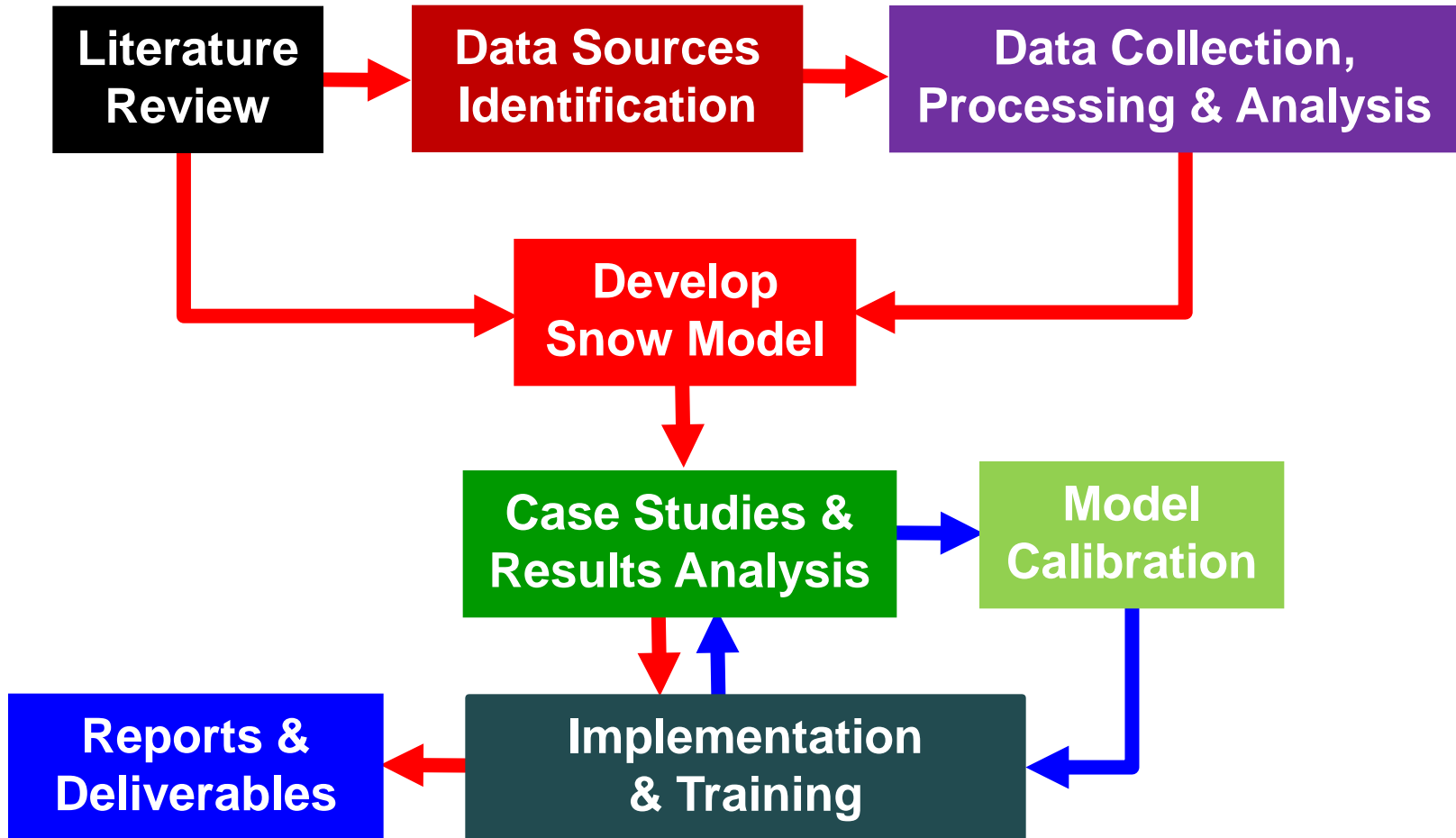
NJ-MDSS would recommend 'Plow only' during this time period if snow on road surface was over 1 inch

Close Print

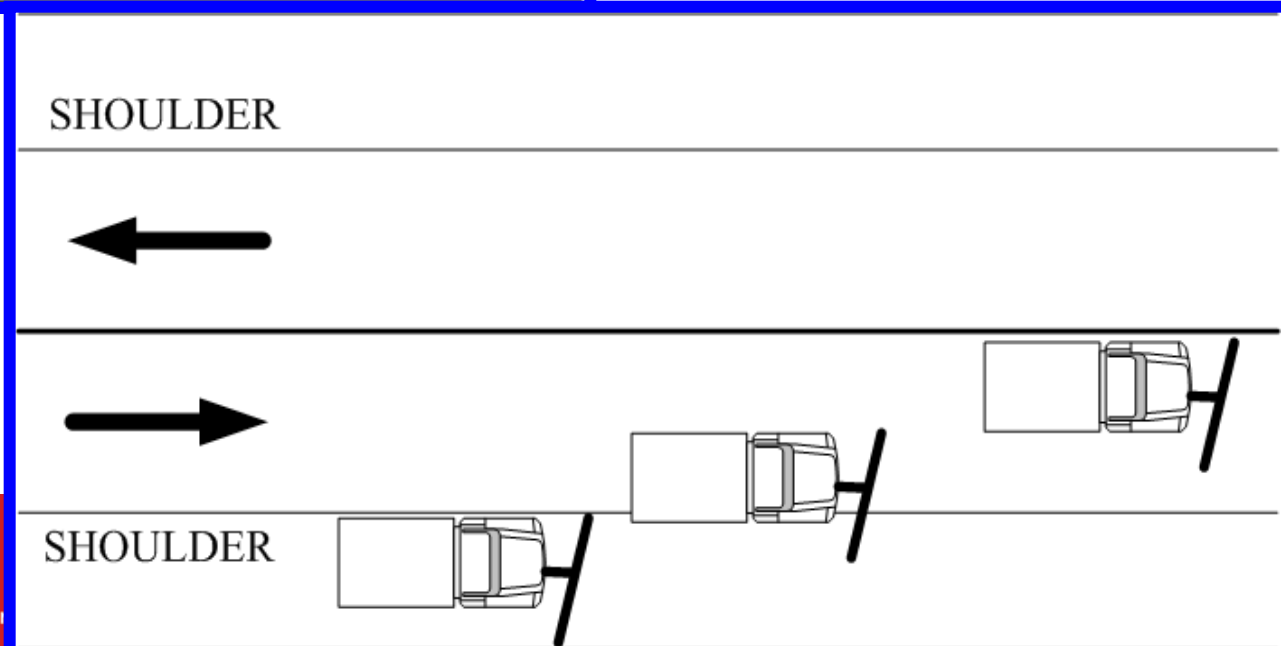
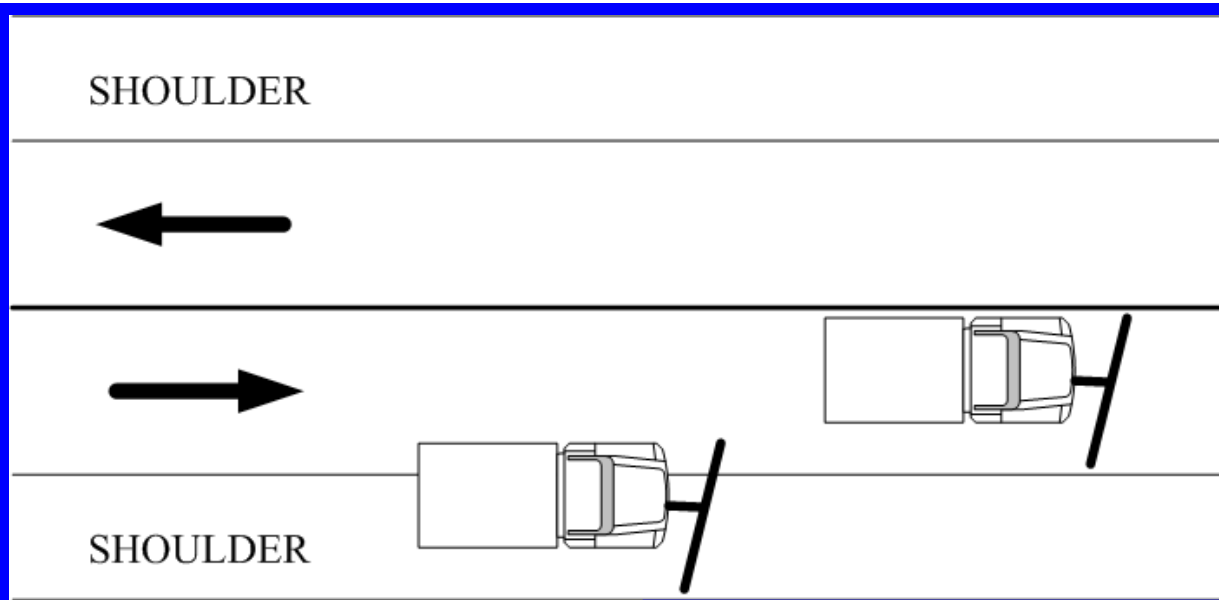
# Snow Model for NJDOT

- Develop a new Snow Model for NJDOT based on the expected snow fall to determine (more plowing less spreading):
  - **how many trucks overall** needed to clear the roads?
  - **how much time** needed to clear the roads?
- In addition to lane-mile, the new Snow Model includes:
  - Types of roadways (freeways, arterials, connectors, etc.)
  - Traffic volume (ADT), speed over time and traffic signals
  - Rural vs. urban areas
  - Time of the day

# Research Approach

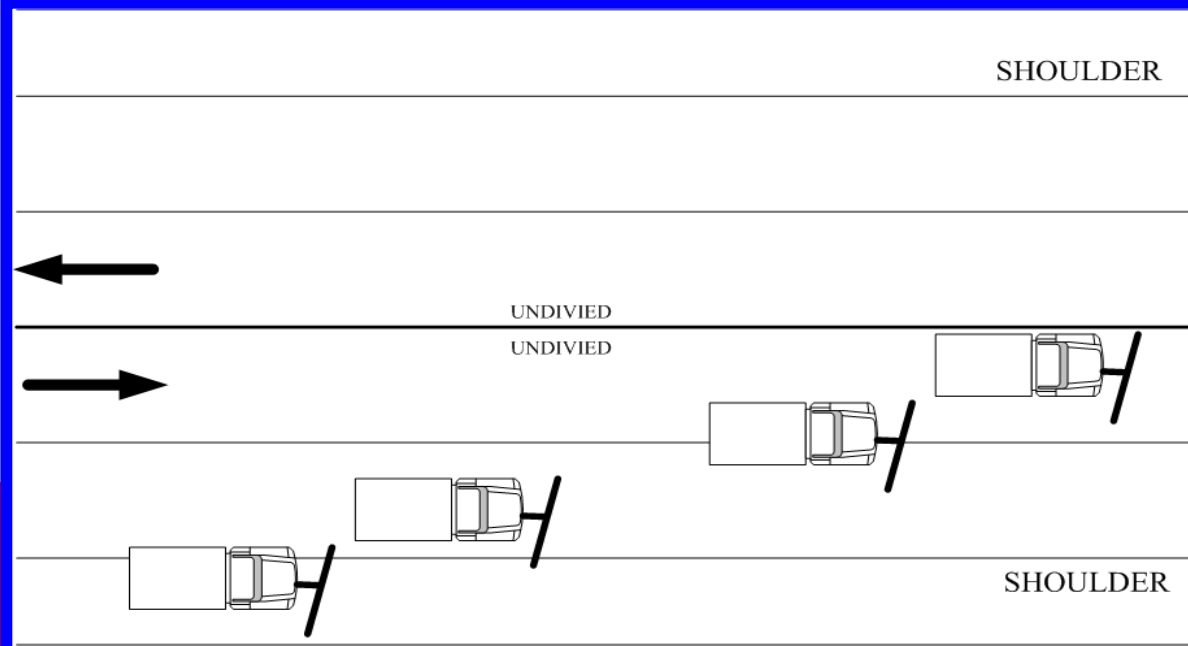
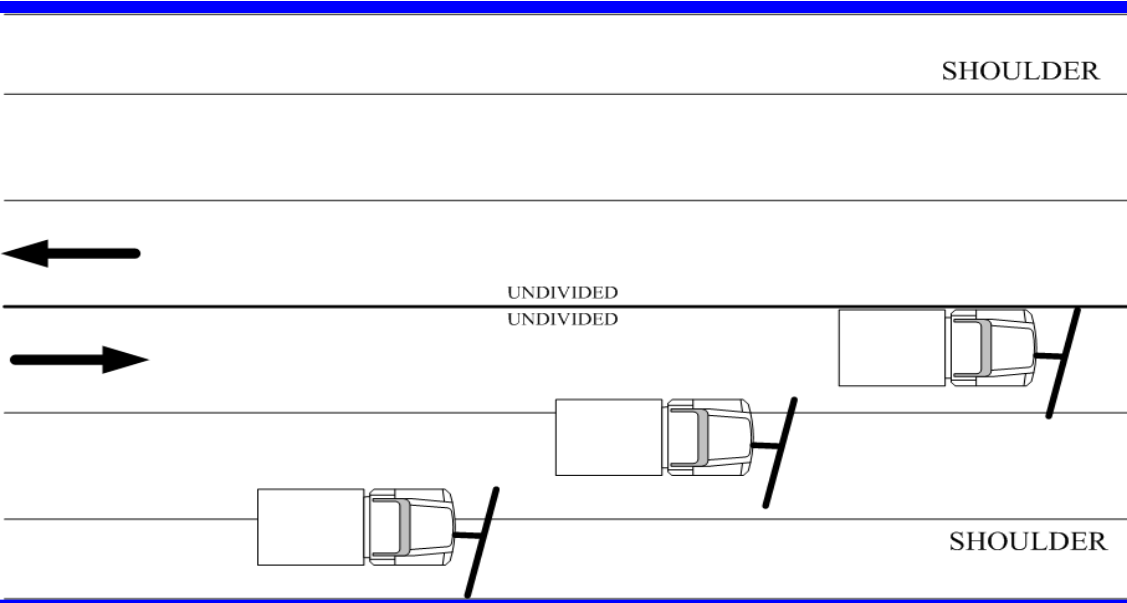


# Two Lane-Two Way Traffic



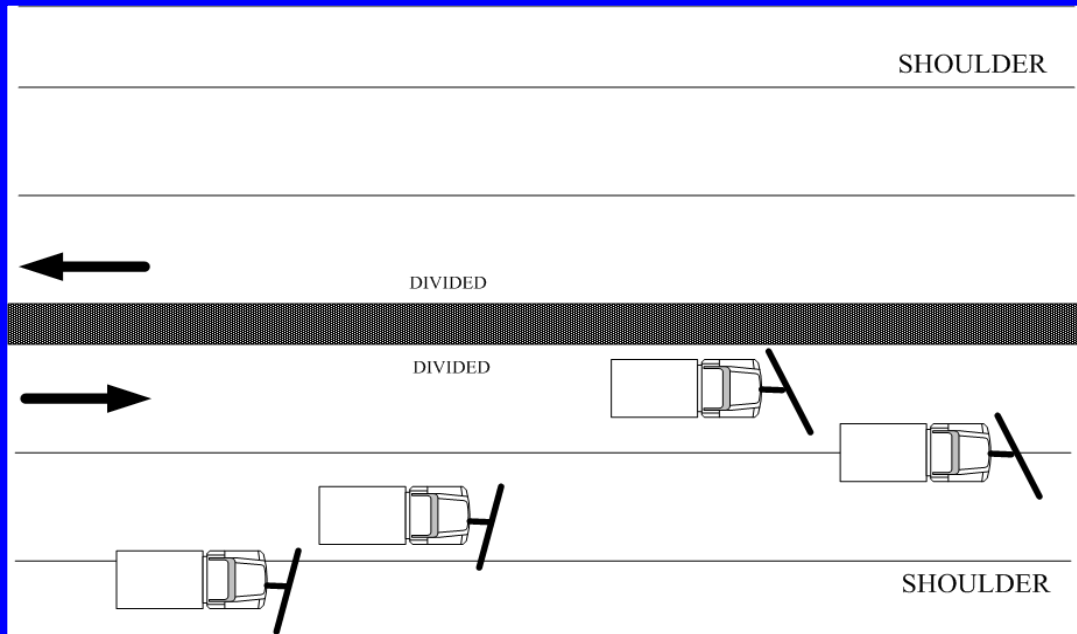
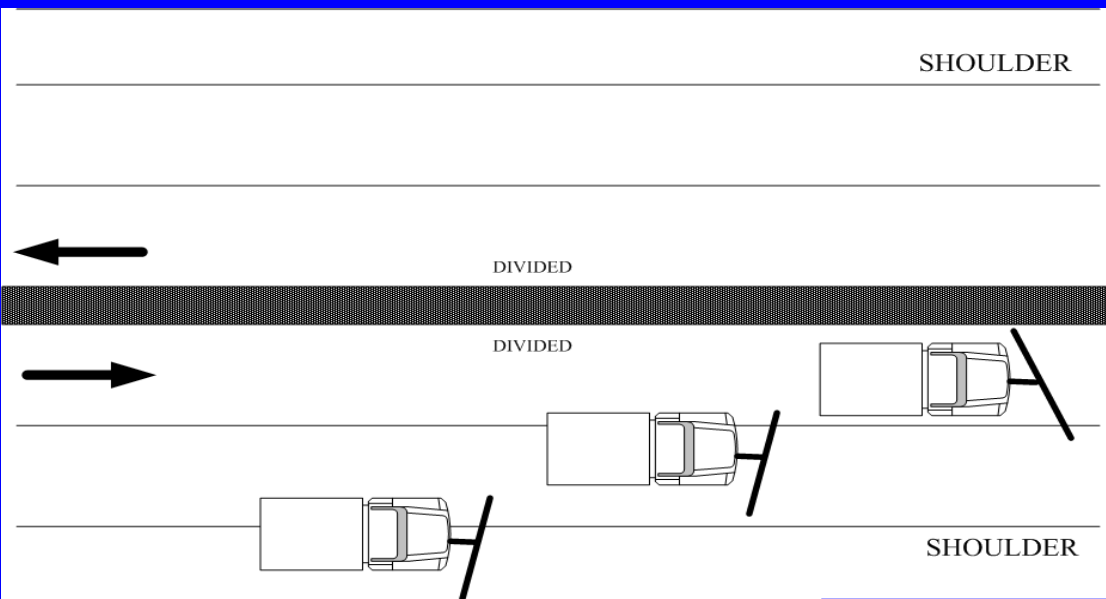
# Two Lane Section –One Way Traffic

(undivided highway)

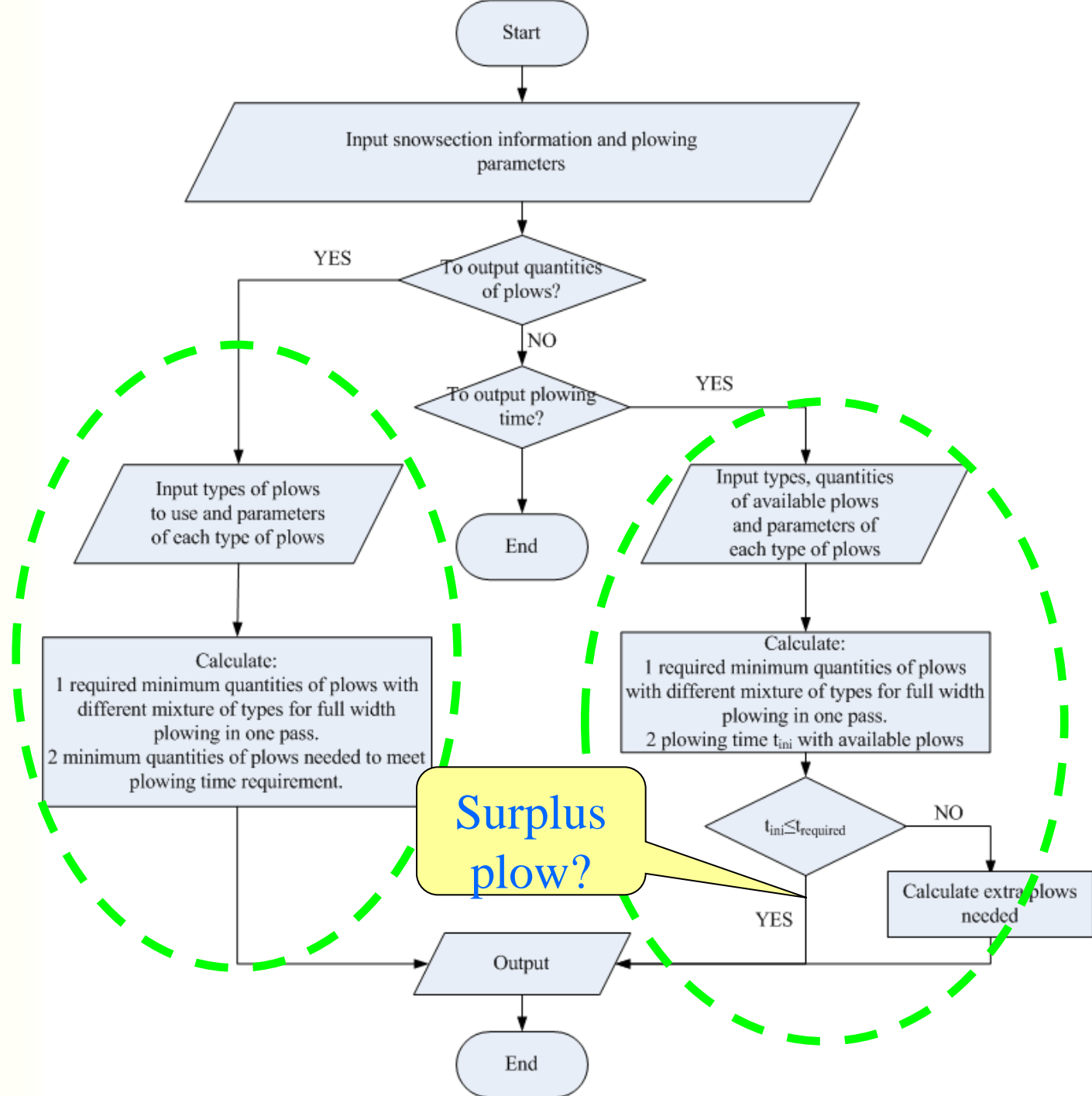


# Two Lane Section –One Way Traffic

(divided highway)



# FLOW CHART



# Summary and Conclusions

- Discussed four technologies that are not widely used in NJ.
- With the adaptation of these four technologies we can substantially reduce the usage of environmentally damaging salt.

# Thank You !

