# Emergency Operations Methodology for Extreme Winter Storm Events

University of Vermont

CLEAR ROADS

research for winter highway maintenance

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# Emergency Operations Methodology for Extreme Winter Storm Events
# FINAL REPORT

*Prepared by:*

James Sullivan
Jonathan Dowds
Transportation Research Center
University of Vermont

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# TABLE OF CONTENTS

## LIST OF FIGURES

# LIST OF ABBREVIATIONS

AASHTO – American Association of State Highway and Transportation Officials

AVL – Automatic vehicle location

DEM – Department of Emergency Management

DHS – Department of Homeland Security

DOT – Department of Transportation

EMAC – Emergency Management Assistance Compact

EOC – Emergency Operations Center

EOP – Emergency Operations Plan

ESF – Emergency Support Function

FEMA – Federal Emergency Management Agency

FHWA – Federal Highway Administration

HERO – Highway Emergency Response Operators

ICS – Incident Command System

NRF – National Response Framework

NWS – National Weather Service

OEM – Office of Emergency Management

RSIC – Roadway snow and ice control

RWIS – Road Weather Information System

SEOC – State Emergency Operations Center

SOP – Standard Operating Procedure

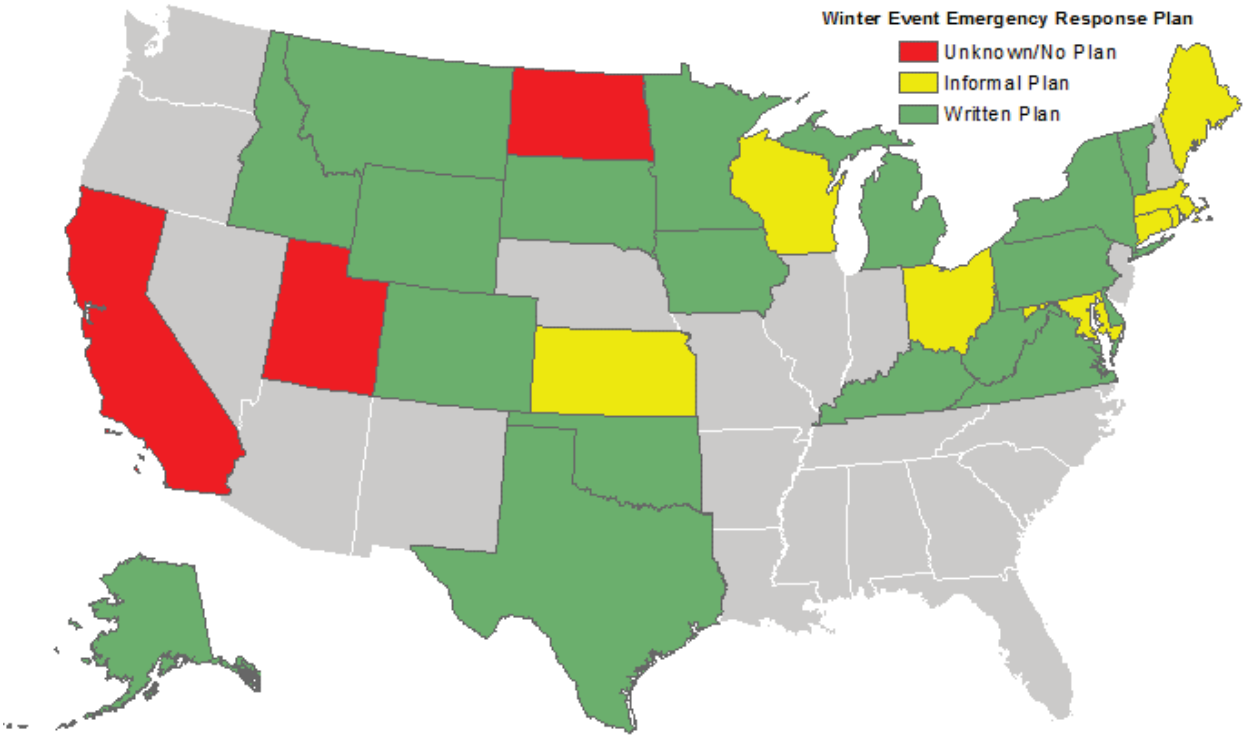
SP – State Police

Note, several additional state-specific acronyms are not listed here but are defined when they are first introduced in the text.

# EXECUTIVE SUMMARY

Winter storms have increased in frequency and intensity since the 1950s and average annual precipitation is projected to continue to increase across the northern United States (Melillo et al., 2014). In response to these trends, many states have developed, or are interested in developing, emergency-response plans for extreme winter storm events. This report provides a series of six emergency-response plan case studies as well as a synthesis of best practices related to emergency-response planning for extreme winter weather. It is intended to provide a blueprint for transportation agencies seeking to develop or improve their own extreme winter weather emergency-response plans, including how to coordinate an effective response across multiple agencies and jurisdictions.

In order to identify state DOTs and other entities that had written emergency-response plans for severe winter weather, a survey was distributed to Clear Roads members, the AASHTO snow and ice listserv, and staff at state DEMs in Clear Roads' member states. In total, 52 individuals responded to the survey. The reported status of emergency-response plans for winter weather for responding state DOTs are shown below.




After email follow-up with the 18 DOT respondents reporting that their agencies had a written plan, 8 written plans were obtained for review (Colorado, Minnesota, New York, New Jersey, Pennsylvania, South Dakota, Texas and Vermont). An additional web search for statewide DEM "all-hazard" plans was conducted to supplement the survey, given the relatively low response rate by emergency managers. (Georgia, Michigan, Minnesota, New York).

Based on the reviews, interview-based case studies were conducted for the following six states:

- Colorado
- Georgia
- Michigan
- New York State
- Pennsylvania
- South Dakota

The in-depth interview process was particularly valuable for gathering detailed information about (1) the organizational structure of the DOT section responsible for the plan, (2) plan implementation, and (3) the differing approaches of the case study subjects to managing an emergency response to extreme winter storms. In addition to the six state case studies, a brief overview of the role of the I-95 Corridor Coalition in facilitating cross-jurisdictional response planning is also included.

A framework of recommended best practices was distilled from the six interview-based case studies to provide a roadmap for other DOTs creating or updating their own written emergency-response plan for extreme winter weather. Best practices that were common to multiple case studies and easily transferable to other jurisdictions were included in the framework. The nine best practices identified in the case studies fell into two general categories, summarized in the table below.

| Category | Recommended Best Practice |
|---|---|
| **Organization & Communication** | DOT Office(r) of Emergency Management |
| | Pre-Event Structured Conference Calls |
| | Public Communications Plan |
| | Extensive road-weather information systems (RWIS) and automatic vehicle location (AVL) Coverage |
| | Regional Coalitions |
| **Planning, Training, and Review** | Scalable RSIC Operations Plan |
| | Legal Authority for Road Restrictions |
| | Threat Identification and Assessment |
| | Formalized Training and Review |

# CHAPTER 1: INTRODUCTION

Emergency-response planning is defined as strategy for minimizing adverse impacts on public safety and economic activity from anthropogenic and natural disasters. It has its origins in Cold-War-era nuclear preparedness planning and now includes planning for many incident types (Alexander, 2002). Extreme winter weather is not currently a well-developed area for emergency-response planning. The two natural disasters identified in the Federal Emergency Management Agency's (FEMA) National Planning Scenarios, for example, are major hurricanes and earthquakes (FEMA, 2009). Nonetheless, the frequency and intensity of winter storms have increased since the 1950s and average annual precipitation is projected to continue to increase across the northern United States (Melillo et al., 2014). Consequently, many states have developed or are interested in developing emergency-response plans for severe winter storms.

In the context of natural events, an emergency can be defined as "an exceptional event that exceeds the capacity of normal resources and organization to cope with it" (Alexander, 2002). State departments of transportation (DOTs) are well prepared to manage most winter storms with routine roadway snow and ice control (RSIC) resources, so most winter storms do not rise to level of an emergency. Only the most severe winter storms – or storms that coincide with other hazards such as an industrial accident (Mendonca, Beroggi, and Wallace, 2001) – will require implementation of an emergency-response plan when the DOTs resources would otherwise be overwhelmed. During emergencies, the transportation system must be capable of facilitating several key activities to protect public safety and minimize economic disruption. These activities, adapted from (Litman, 2006), include:

- Ensuring ability to deliver emergency supplies and services (including police/fire)
- Maintaining access to critical infrastructure/facilities, like hospitals and power stations
- Maintaining capacity of evacuation routes
- Facilitating infrastructure repair

Winter storms present a different set of challenges relative to other natural disaster types. Heavy snowfall, especially when accompanied by high winds, causes drifting snow and poor visibility. Sidewalks, streets, and highways can become hazardous to pedestrians and motorists. Extreme low temperatures can exacerbate these effects and make infrastructure and isolated populations more vulnerable. Winter storms generally do not cause the same degree of infrastructure damage as other natural disasters and rarely require population evacuations. However, they can be longer lasting and wider in geographic coverage than other types of natural disasters. The uniformity of the damage caused by severe winter storms also has a more disruptive effect on mobility than more localized disruptions from, for example, flooding. Damage to infrastructure can include power outages, while personal safety and mobility impacts include increased accident rates, increased travel times, cold-induced injuries and inability for relief services to respond to vulnerable populations.

Because winter storms limit mobility, RSIC resources are needed to maintain access to critical infrastructure, including hospitals, power facilities such as sub-stations, and fueling facilities (especially for RSIC vehicles themselves). During extreme winter storms, standard RSIC resources are stressed by

this task. For example, in the winter of 2015, a series of extreme storms in Massachusetts resulted in the activation of the State Emergency Operations Center (SEOC) for 28 consecutive days. Record snowfall resulted in multiple State of Emergency declarations, travel bans and extensive deployment of Massachusetts State Police and National Guard resources (MEMA, 2015). In spite of intensive RSIC at the state and local levels and Emergency Management Assistance Compact (EMAC) support from five neighboring states, the storms caused extensive, long-term transit and highway closures (MEMA, 2015).

A variety of services are integral to a safe and effective response during a severe-to-extreme winter storm event:

- State Police
- Fire and Rescue
- Emergency Operations Center (EOC) and Incident Command System (ICS)
- RSIC Operations

In many states, these services are coordinated and integrated through the SEOC in times of emergency (VDPS, 2015). Following the *National Response Framework* (NRF), response resources and services are frequently organized around Emergency Support Functions (ESFs), structures that coordinate the delivery of core emergency response capabilities (DHS, 2016). Although DOT operations personnel are included in the ESF structure and active in emergency operations, it is not clear how RSIC services are coordinated with first responders and relief providers. Since RSIC services are normally coordinated out of local "districts" or "service areas", there are also jurisdictional challenges associated with coordinating RSIC response. During extreme winter weather, RSIC response typically requires the support of RSIC personnel and equipment from districts that are not directly affected by the storm, potentially including mutual aid from districts outside the affected state(s). Beginning in 2006, all sub-recipients of Homeland Security Grants were encouraged to form mutual aid agreements as a condition of receiving federal preparedness funds.

## 1.1 GOALS OF THE PROJECT

The goal of this project is to provide a synthesis of best practices in emergency-response planning for extreme winter weather for transportation agencies seeking to develop or improve their own emergency-response plans. To achieve this goal, this project uses a case study approach that facilitates the identification of best practices and provides concrete examples of the practices in action. These case studies, and the recommended best practices drawn from them, are intended to provide the blueprints for how an effective response will be coordinated between multiple agencies and jurisdictions who may not normally interact on a day-to-day basis.

## 1.2 BACKGROUND

The NRF includes five emergency-preparedness components - mitigation, response, recovery, protection and prevention (DHS, 2016). The focus of this project is specifically on the *response* aspect of emergency-preparedness planning, which the Department of Homeland Security (DHS) defines as the

activities “necessary to save lives, protect property and the environment, and meet basic human needs after an incident has occurred” (DHS, 2016).

The NRF articulates five “guiding principles” as the basis for incident responses (DHS, 2016). These are:

(1) engaged partnership
(2) tiered response
(3) scalable, flexible, and adaptable operational capabilities
(4) unity of effort through unified command
(5) readiness to act

Collectively, these principles emphasize the importance of clear and effective coordination among stakeholders, flexibility in bringing additional resources to bear, as well as preparation and training. In addition to state, local and federal emergency responders and DOTs, stakeholders include the public and the business community. In the context of extreme winter weather, effective communication with businesses and the traveling public about road conditions and travel restrictions can reduce accidents and congestion and improve the ability of DOTs to perform critical RSIC operations. Flexible operational capabilities can include seamlessly increasing staff and implementing overtime for RSIC operators, shifting resources from low- to high-priority roadways, efficiently using RSIC contractors, and requesting assistance from neighboring jurisdictions, through an EMAC for example. State and local resources are often managed using ICSs that coordinate response activities through EOCs (DHS, 2016).

The response process itself is an iterative process of information-gathering, resource activation/deployment, and coordination of response activities. Effective response efforts are supported by a preparedness process that includes developing a plan, organizing and training personnel, conducting training exercises, and evaluating and improving the response plan (DHS, 2008).

Academic sources emphasize that ongoing review of the emergency-response plan is essential and that the planning process should not be considered complete simply because a written plan has been produced (Perry and Lindell, 2003). A written plan only represents the state of the planning process at the time that it is produced, so it needs to be part of a continuing process of testing and revision. This ongoing process combats complacency and the inherent human tendency to underestimate the likelihood of infrequent events. Perry and Lindell (2003) also distinguish the process of planning from the management phase of a response, which occurs during the event itself. A written plan should also include standard operating procedures (SOPs) for management of the response once an emergency arises.

In addition to the direct impacts caused by extreme winter storms – notably the loss of mobility due to the accumulation of snow and ice on roads or from diminished visibility while driving – the operation of the transporation system can be further compromised by other factors. These factors include failure to provide clear instructions to the public, failure of the public to comply with instructions, and failure to maintain access to transit and to fuel, all of which occurred during Hurricanes Katrina and Rita. The transportation system is critical to public safety, especially when the needs of those without basic mobility options are considered (Litman, 2006).

## 1.3 REPORT SUMMARY

Chapter 2 describes the survey and literature review process that were used to identify specific case studies for this project. It includes a review of the survey results, the written emergency-response plans obtained for review, and the written all-hazard plans that were discovered with specific attention to extreme winter storms, as well as a recommendation for the case studies to be pursued. Chapter 3 presents the interview-based case studies that are the source of the recommended best practices summarized in Chapter 4. Chapter 5 describes the overall project conclusions and needs for future research.

# CHAPTER 2: SURVEY AND LITERATURE REVIEW

In order to support the development of guidance on emergency-response planning for extreme winter weather, this chapter describes the process of identifying potential case studies subjects through a literature review and survey. It contains:

- Overview of Survey Results and Written DOT Plans Obtained for Review
- Review of Written DOT Plans
- Overview of Written All-Hazard Plans
- Recommended Set of Case Studies

## 2.1 OVERVIEW OF SURVEY RESULTS AND WRITTEN DOT PLANS OBTAINED FOR REVIEW

In order to identify DOTs and other entities that have written emergency-response plans for severe winter weather, a survey was distributed to Clear Roads members, the AASHTO snow and ice listserv, and staff at the state DEMs in all Clear Roads' member states. In total, 52 respondents completed at least a portion of the survey. These respondents included 30 DOT or local public-works personnel, but only two respondents from state departments of emergency management. The reported status of emergency-response plans for winter weather events for responding state DOTs are shown in Figure 1.

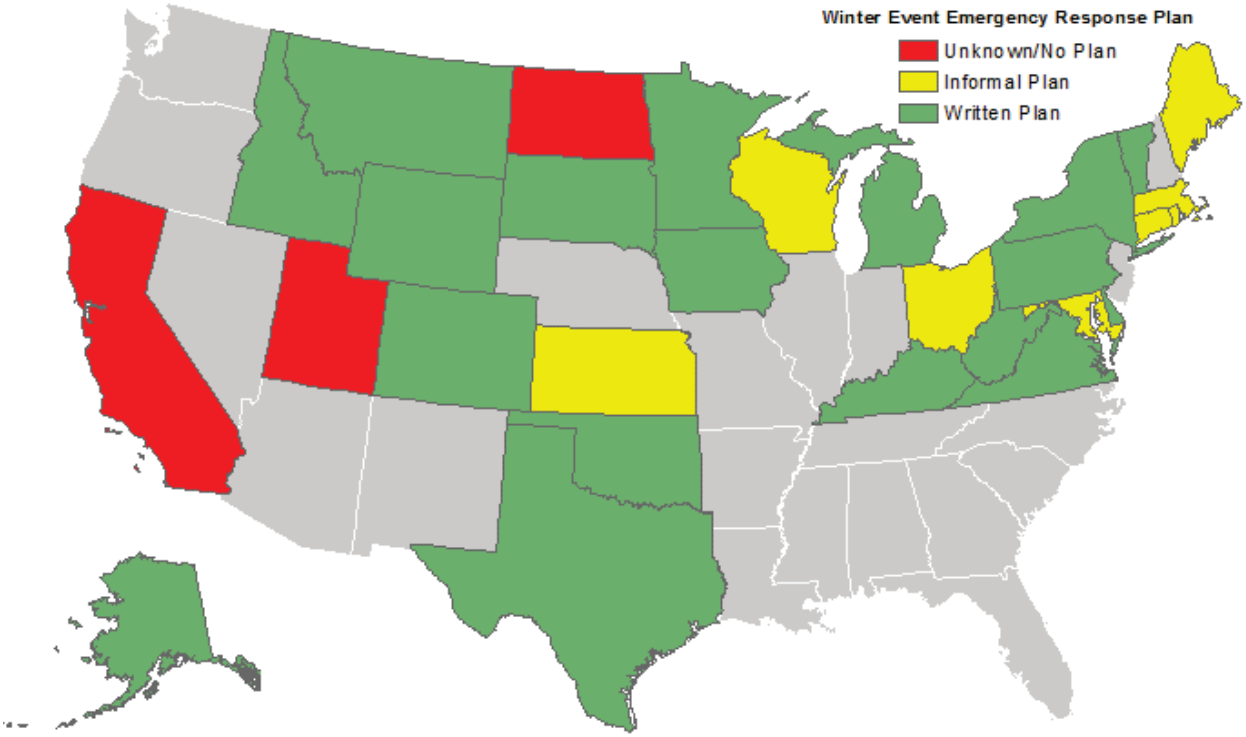



**Figure 1. Status of emergency-response plans for state DOTs participating in the project survey**

Twenty three of the respondents answered “yes“ when asked if their state had a written plan for emergency response to extreme winter storms. Twenty of these responses came from state DOTs, representing 19 different states (one state had two “yes” responses). However, the Michigan respondent failed to provide contact info. So a total of 18 states (shown in Figure 1) were confirmed to have responded affirmatively. Two local agencies also responded with a “yes”, but one of them failed to provide contact info and the other failed to respond to the follow up. The final affirmative response came from a vendor.

Note that in three of the 18 cases, one respondent from the state DOT reported that the agency *did* have a written emergency-response plan while a second respondent from the same DOT reported that the agency *did not* have a plan or only had an informal plan. These types of contradictions reinforce the need for emergency-response plans that are well integrated throughout multiple state agency’s operations.

Survey respondents primarily listed specific weather criteria as the trigger for their emergency response plan, as opposed to a FEMA or Governor’s declaration. Specific triggers included:

- Storm severity
- Forecasted or anticipated weather
- Over 8 inches of snow in 24 hours or less
- Impacts to critical routes or other roadway conditions
- Standing agreement with the local airport
- Determination made at the district level

Most respondents who affirmed that they have a written plan felt that it covered intra-agency communications, demobilization of resources, and after-action review well, but did not cover the shifting of resources or updating the plan well. Nor did they feel that their plans covered life-safety measures for stranded travelers or vulnerable residents.

After email follow-up with the 18 DOT respondents reporting that their agencies had a written plan, eight respondents provided a copy of the written plan(s) they referred to in the survey:

- Colorado:
    - Colorado Department of Transportation (CDOT): Threat and Hazard Identification and Risk Assessment, March 2017
    - CDOT: Emergency Operations Plan, June 2017 (Draft)
    - CDOT: Standard Operating Procedures, August 2017 (Draft)
    - Colorado Division of Homeland Security & Emergency Management: Colorado Hazard and Incident Response and Recovery Plan, November 2016
- Minnesota Department of Transportation (MnDOT) Department-Wide Snow and Ice Plan, Season: 2017 – 2018, June 2017
- New York State Department of Transportation (NYSDOT): Emergency Transportation Operations Playbook, Revised October 2016

- New Jersey Department of Transportation (NJDOT): Operations Winter Readiness Levels (Undated)
- Pennsylvania:
    - Pennsylvania Department of Transportation (PennDOT): All-Hazards Incident Management System Manual, December 2014
    - PennDOT Bureau of Maintenance and Operations Maintenance Manual, Chapter 9: Emergency Operations, Updated 4/15
- South Dakota Department of Transportation (SDDOT): Winter Highway Maintenance Plan, 2016-2017, October 2016
- Texas Department of Transportation (TxDOT): Texas Snow and Ice Control Plan, TxDOT Maintenance Division-Winter Storm Committee (Undated)
- Vermont Agency of Transportation (VTrans): Emergency Operations Plan, September 2015

An additional web search for state all-hazard plans or statewide emergency-response plans was conducted to supplement the survey, given the relatively low response rate by emergency managers. Since all-hazard plans contain considerably less detail about individual incidents than a DOT response plan would, the review of these plans was limited to four states:

- Georgia: Georgia Emergency Management and Homeland Security Agency Winter Weather Incident Annex S - Georgia Emergency Operations Plan, 9/7/2016
- Michigan: Michigan Emergency Management Plan, February 6, 2017
- Minnesota: State of Minnesota Emergency Operations Plan (Official), Revised September 1, 2013
- New York: 2014 New York State Hazard Mitigation Plan, January 2014
- New Jersey: State of New Jersey 2014 Hazard Mitigation Plan

The written DOT plans are reviewed in Chapter 2.2. Since the Colorado DHSEM (DHSEM, 2016) is not a DOT plan, it is discussed with the other all-hazard plans in Chapter 2.3.

## 2.2 REVIEW OF WRITTEN DOT PLANS

### 2.2.1 Colorado

The survey respondent from the Colorado DOT provided three separate written DOT documents pertaining to emergency-response to extreme winter weather. The 2017 Colorado Threat and Hazard Identification and Risk Assessment (CDOT, 2017a) addresses most of the threats and hazards that transportation faces in Colorado, including severe winter weather. This is a supporting document to the overall State Hazard Mitigation Plan. The specific maintenance regions where threats of severe winter weather are highest are identified, and very specific definitions/distinctions are made between winter-weather hazards that involve extreme winter precipitation, extremely strong winter winds, and extremely low winter temperatures. Based on these distinctions, the document includes a temporal chart indicating which hazards are present in which month of the year. Projected impacts of severe winter weather, ice and sleet, snowstorms, severe winds, extreme cold, and avalanche are itemized

separately for the public, first responders, infrastructure, the economy, the environment, public confidence, and DOT operations.

The 2017 Emergency Operations Plan (EOP) (CDOT, 2017b) is the first of its kind prepared by CDOT, with a focus on state transportation-agency responsibilities during an emergency. It includes specific definitions of the terms snow advisory, wind chill advisory/warning, and winter storm advisory/watch/warning, along with a specific description of the scope of a "winter storm":

> *Hazardous winter weather includes events related to heavy snow, blowing snow, ice, sleet or freezing rain, and extreme cold temperatures. Blizzards are severe winter storms that pack a combination of blowing snow and wind resulting in very low visibilities.*

Its preparedness procedures also cover avalanche control as a mitigation measure.

The 2017 Draft Standard Operating Procedures (SOPs) (CDOT, 2017c) cover severe winter weather in SOPs relating to Crisis Communication Planning, Incident Action Planning, and the Winter Operations Conference Call. The SOP for the Winter Operations Conference Call includes additional detail on the roles and responsibilities of entities within CDOT and other state agencies, a concept of operations with a list of specific participants for the calls, and a decision tree for determining the "incident level", which dictates the initial set of communications and whether a conference call is needed.

### 2.2.2 Minnesota

The MnDOT 2017 – 2018 Snow and Ice Plan (MnDOT, 2017) identifies class-specific performance-measure targets for RSIC, which enable RSIC resources to be concentrated preferentially on the highest priority roadways during severe winter-weather events. The plan also allows for scaling of the RSIC resources deployed depending on storm severity, describing split-shift and overtime policies that can be implemented when severe winter-weather is forecasted. It states that MnDOT RSIC trucks are estimated to be sufficient to meet its level of service targets given "moderately severe" winter-weather events. Extreme events are not specifically addressed in the plan nor is interagency communication or collaboration discussed.

### 2.2.3 New Jersey

New Jersey DOT provided a 2-page "readiness plan" for RSIC activities (NJDOT, 2017). The plan dictates the activation of RSIC in response to escalating storm conditions. Level 1 is a monitoring level that provides for "eyeballs on the road and the sky." At this level, RSIC crews and contractors have not generally been activated. Level 4 is the highest level of operational readiness in which all available resources are being utilized for RSIC operations. Level 5 readiness is for extreme winter storms and provides a framework for decision-making regarding states of emergency, travel bans, towing edicts, state office closures, shelter-in-place protocols, and activating of RSIC contractors, on-call drivers and commercial resources. The Level 5 readiness level is only implemented when forecasts predict a

combination of high snowfall rates (> 2" per hour), long storm durations, high total accumulations (> 20") and high winds. Under these conditions, RSIC crews would be expected to struggle to keep roads clear, county and local RSIC resources are likely to be overwhelmed and motorist stranding could be common. The plan allows for the flexible escalation of resources as needed and includes a protocol for changes in readiness levels, and roles for both state and regional EOCs. Collaboration with adjoining states, communication with the public and specific allocation of resources to critical infrastructure are not directly addressed in the plan.

### 2.2.4 New York

The NYSDOT Emergency Transportation Operations Playbook (NYSDOT, 2016) governs NYSDOT response to incidents of all types using an Incident Command System structure outlined in the National Incident Management System. Preparedness is managed through the Statewide Transportation Information & Coordination Center, which has capacity for expanded staffing during major events in order to coordinate with the state Office of Emergency Management (OEM) and other agencies and coordinate the deployment of resources. Transportation Management Centers are responsible for the coordination of operational activities and coordination with state and local police. The Playbook also outlines NYSDOT's ability to implement pre-emptive travel bans and other travel restrictions.

Routine winter maintenance at NYSDOT is governed by "Snow and Ice Control Guidelines". The Snow and Ice Guidelines mandate regional operational plans, most of which include additional contingencies for equipment failures, snow showers/squalls, and assistance to adjacent jurisdictions. RSIC plans also have pre-planned enhanced-response components for storms with a forecasted intensity of greater than 1.5 inches per hour, which includes provisions for double coverage of critical highway-segments by shifting resources.

### 2.2.5 Pennsylvania

PennDOT's role in emergency-response to all types of natural disasters is laid out in Chapter 9: Emergency-Response of the DOT's Maintenance Manual (PennDOT, 2015). DOT response duties include participating in the three regional EOCs, collecting and reporting information on damage/disruption to the transportation system (including road, air, rail and bus facilities), assisting in the distribution of emergency fuel supplies, and designating emergency routes. Debris removal (including removal of snow) is identified as a key responsibility of the DOT.

### 2.2.6 South Dakota

The South Dakota Winter Highway Maintenance Plan for 2016-2017 (SDDOT, 2016) includes the emergency procedures for severe winter weather. It stipulates that traffic can be restricted or closed on sections of highway under extreme circumstance. It also provides guidelines for how to communicate these restrictions and travel advisories to the public, for coordination with state police and emergency-responders and for overtime assignment. As with other states, it includes a road prioritization system that permits resources to be diverted preferentially from non-priority roads and a policy to reassign

equipment to neighboring areas during major winter events. The state has a written policy for assisting stranded motorists.

In the event of a winter-weather emergency, South Dakota can activate its EOC to facilitate communication and decision-making. The EOC typically includes the Department of Public Safety, the Department of Transportation, the Department of Environment and Natural Resources, and the South Dakota National Guard.

### 2.2.7 Texas

The TxDOT Snow and Ice Control Plan (TxDOT, 2017) calls for the activation of the Maintenance Division EOC when a winter storm is forecasted to affect multiple districts. The EOC is intended to coordinate movement of RSIC personnel and resources to impacted areas. During major winter storms, the State Operation Center, which is different from the Maintenance Division EOC, may be active as well to provide additional support, by coordinating the activities of the Texas A&M Forest Service, Texas Military Forces, Texas Parks & Wildlife and the Department of Public Safety. Each district is directed to establish an emergency-response team to address issues within its own district and to assist other districts.

### 2.2.8 Vermont

The VTrans Emergency Transportation Operations Plan (VTRANS, 2015) is intended to provide a framework for managing Agency resource during responses to a wide range of incidents. It includes sections on planning and preparedness, response, and post-incident revision of the plan. It also includes a description of the structure and function of the Incident Command System in Vermont. Regardless of the incident type, the Agency is responsible for monitoring the status of the road network and other transportation infrastructure and reporting it to the state EOC.

## 2.3 OVERVIEW OF WRITTEN ALL-HAZARD PLANS

FEMA provides guidance on the development of all-hazard EOPs (FEMA 2010). These plans include a basic plan, which is in place for all emergency types and provides an overview of response policies, agencies and responsibilities. In addition, the EOP should include hazard/incident specific “incident annexes” that address operational response to individual threats. This overview focuses on the incident annexes pertaining to extreme winter storms in the all-hazard EOPs for Colorado, Georgia, Michigan, Minnesota and New York.

### 2.3.1 Colorado

The 2016 Colorado Hazard and Incident Response and Recovery Plan (DHSEM, 2016) is the statewide EOP that is used at the EOC in Colorado when an emergency is activated. It covers both response and recovery, highlighting the interaction amongst the various state agencies. It mentions severe winter storms as a frequent major event requiring disaster declaration, and includes a winter-storm incident

annex, describing who will be the lead agency, what assumptions have gone into planning for the incident, and what the specific roles and responsibilities are for other agencies. A "Concept of Operations" is also provided, with general guidance on the goals of the response and the general roles of other state agencies and state agency partners (non-government organizations and private entities).

### 2.3.2 Georgia

The Georgia EOP includes a winter-weather incident annex that provides an overview of how the state coordinates response to significant winter-weather incidents (GEMA/HS, 2016). The annex recognizes that while winter weather does not pose a significant problem every winter, the state has experienced winter-weather events (especially related to ice) that have overwhelmed its emergency-response and RSIC capabilities. The document's Concept of Operations lays out five levels of operational preparedness that are triggered by forecasted weather conditions, as well as coordination between GEMA/HS and GDOT.

### 2.3.3 Michigan

The Michigan Emergency Management Plan includes a disaster-specific procedure for severe winter weather (MSP/EMHSD, 2016). This procedure identifies four winter-weather hazards that occur in Michigan: snowstorms, blizzards, extreme cold, and ice storms. These hazards are assessed based on the potential extent and duration of the storm, number of injuries and fatalities, property/environmental/agricultural damage, impacts on infrastructure, and resources required for response and recovery. In addition to assessing the severity of the weather event, the severe winter-weather procedure identifies mechanisms for notifying the public and requesting federal assistance. MDOT is also identified as the lead agency for public works and engineering ESFs for all disaster types. These support functions include RSIC and other infrastructure maintenance operations.

### 2.3.4 Minnesota

The Minnesota Emergency Operations Plan identifies blizzards as a threat to the state but does not include annexes for specific hazards (MnDPS/HSEM, 2013). The EOP does identify a public awareness campaign for winter hazards and describes the specific DOT responsibility for debris removal and maintenance of evacuation/supply routes for multiple emergency types (other than winter-weather emergencies).

### 2.3.5 New York

The New York State Hazard Mitigation Plan recognizes severe winter weather as a high probability event but characterizes it as a low threat due to the low potential for loss of life relative to other disaster types (NYSDHSES, 2014). It provides an extensive summary of historical storm events, probabilities for future events and identifies the Northeast Snowfall Impact Scale as an effective means for assessing storm severity (Squires and Lawrimore, 2006).

### 2.3.6 New Jersey

The State of New Jersey 2014 Hazard Mitigation Plan has a section dedicated to assessing risk from severe winter weather, which are defined to include heavy snow, blizzards, and ice storms (Tetra Tech, 2014). They utilize the Regional Snowfall Index ranking categories, created by National Oceanic and Atmospheric Administration (Squires et. al., 2014) to assess the risk from heavy snowfall. Risks to human life are identified as traffic crashes, heart attacks due to over-exertion, and prolonged exposure to cold. It also includes a detailed catalog of winter weather emergencies historically, along with a monetary estimate of the potential losses across many sectors, including transportation. Since it is a mitigation plan, this document contains little to no information on response, but does include some important elements that could be used to develop a plan or incident annex.

## 2.4 RECOMMENDED SET OF CASE STUDIES

State DOTs are at significantly different stages of development in emergency-response planning for extreme winter weather. Existing plans are highly variable in their level of detail, and coordination of plans between DOTs and emergency management agencies is not always evident. The following features were identified through the review as critical components of a state's emergency-response plan for extreme winter-weather events:

1) Criteria for winter-storm severity classified by event type – snow, wind, ice, and low temperature
2) An initial communication kickoff event, like a Winter Storm Conference Call
3) Clarification about whether the DOT has the responsibility to reduce speed limits and/or close sections of roadway
4) Temporal (monthly) and geographic (by district) identification of threats by event type
5) An RSIC resource-supplementation plan describing how split-shifts, overtime policies, contractors, regional resource-shifting and out-of-state assistance are to be implemented or engaged in extreme winter-weather
6) A specific plan for reducing/focusing the scope of RSIC to the most critical routes/facilities
7) Emergency procedures that dictate how the DOTs RSIC procedures will be coordinated with:
   a) The state's EOC and the DEM
   b) State police and emergency-responders
8) A winter-weather incident annex, as usually contained in the state's all-hazard plan, with procedures for organizing and training personnel, conducting training exercises, and evaluating and improving the response plan
9) A communication/coordination plan that includes state and local responders, emergency managers, RSIC operations staff, the public, non-profits, and major employers
10) Scalability for use by states with frequent severe winter storms as well as those for whom winter storms are less frequent
11) Consistent terminology, for better coordination of resources and sharing of written plan materials

Based on the emergency-response survey, the follow-up contact with DOT staff and the literature review, the research team recommended case studies on the development of written plans in the following states:

- Colorado
- New York State
- South Dakota
- Georgia
- New Jersey
- Pennsylvania
- Michigan
- Texas

Each of these states has made significant progress in planning around the threat of winter-weather emergencies, but each has focused on a different aspect of the planning.

The importance of inter-agency coordination is stressed in all emergency planning documents, but multi-state engagement seems to be an area where improvements specifically related to winter storms can be made. The I-95 Corridor Coalition (http://i95coalition.org/) is a cooperative multi-state organization that has developed around issues of transportation management and operation in the I-95 corridor. TRANSCOM (https://xcm.org/XCMWebSite/Index.aspx) is a coalition of 16 transportation and public safety agencies in the New York – New Jersey – Connecticut metropolitan region. It was created in 1986 to provide a cooperative, coordinated approach to regional transportation management. The research team also recommends an informal review of the capabilities of these types of organizations in facilitating resource and information sharing among states during extreme storms.

# CHAPTER 3: INTERVIEWS AND CASE STUDIES

This chapter presents the interview-based case studies for six state DOTs:

- South Dakota
- Colorado
- Pennsylvania
- Georgia
- New York
- Michigan

Attempts to connect with representatives from New Jersey and Texas were unsuccessful through the end of November 2017, so those potential case studies are not included. The results of an informal review of the potential role of the I-95 Corridor Coalition in facilitating cross-jurisdictional response planning is included.

For most of the interviews, the interviewee was the respondent to the initial survey, but in several cases additional personnel also participated in the interviews. Two of the states included in the case-study analysis, Georgia and Michigan, did not participate in the initial survey but were identified by reviewing their all-hazard plan through an open literature search. For these two states, additional efforts were required to find the most suitable person to interview about their plans.

The interview process consisted of two sets questions. The first set of questions followed-up on the initial survey and/or were designed to gather additional details about each states' emergency-response planning beyond what had been uncovered in the literature review and survey tasks. The questions asked in this portion of the interview varied from state to state. In the cases of Georgia and Michigan, this part of the interview covered the questions from the initial survey.

The second set of questions in the interviews were developed following the case-study process outlined by Erskine et al. (1997) and are intended to understand big-picture issues around winter emergency-response planning in each state and to help others learn through the case-study presentation method. These questions, which were repeated in every interview, were:

1. Define the Issue: *What is the issue or event that prompted the development of the written plan(s)?*
2. Describe the Background / Analyze Case Data: *What is the history of your agency's activity in this area? How have winter weather emergencies been handled in the past?*
3. Generate Alternatives: *What are some of the things that your agency can do better? What tools/resources do you need?*
4. Describe the Proposed Solution: *Is there an intent to incorporate currently omitted critical components of emergency planning for severe winter storm events?*

The fifth step is Erskine's case study process is to make recommendations. Final recommendations from the case-study analysis are in Chapter 4.

## 3.1 SOUTH DAKOTA CASE STUDY

Dan Varilek, Winter Maintenance Specialist with the South Dakota DOT, responded to the initial survey for this project (see sidebar). His response prompted the review of the South Dakota Winter Highway Maintenance Plan for 2016-2017 (SDDOT, 2016), which includes the emergency procedures for severe winter weather, in addition to the procedures for normal RSIC operations.

Dan Varilek and Greg Fuller, Director of the Division of Operations at SDDOT, participated in a follow-up interview on November 13, 2017. The results of this interview are presented below, with questions in bold and answers in italics.

### 3.1.1 Follow-Up to Survey Responses: Additional Details

**Emergency procedures for RSIC are activated "At the direction or request of the Secretary and/or Director of Operations via the Region Engineer," (page 21) – Does the Secretary or Director of Operations make that call? Is the EOC activation a key indicator of an emergency? Is the South Dakota OEM responsible for activating the EOC? Why might they activate it during a major winter storm? Is all communication with other agencies handled through the EOC when an emergency is occurring? Other than the state police, are any other agencies communicated with outside the EOC?**

*Within the DOT, the communication follows a chain of command from the area engineers, up to the four region engineers, who report to the Director (Greg Fuller). When the area engineers run into issues with equipment or personnel, they begin the process of going up that chain of command to the Director, who makes the call to shift resources. Therefore, the request to move resources between districts comes directly from the users of resources at the lowest level. Although this is a form of response, it is not related to the activation of the EOC.*

### SOUTH DAKOTA SURVEY RESULTS

What are the "trigger criteria" for implementing the response plan? *Governor's Declaration and Local/County Declaration*

Does the plan include specific rules for communication between jurisdictions/agencies to facilitate the response? *Yes*

Are the roles of each jurisdiction/agency clearly defined? *Yes*

Are any documented memoranda of understanding between agencies available? *Yes*

Does the plan cover communication between snow and ice control managers and emergency responders (e.g. police, fire and rescue and regional emergency managers)? *Yes*

Does the plan call for an agency representative to staff or report to local jurisdiction emergency operations centers? *Yes*

Does the plan specifically address life-safety measures necessary for stranded travelers and/or vulnerable residents? *Yes*

How are resources demobilized after the event is over and the response has been completed? *We touch base with our Area Engineers to determine what equipment is necessary to open up the roads. Once established our fleet manager will arrange for equipment to be transferred to those areas for use. Once the area is deemed safe for public transit, the equipment will be transferred back to its original home.*

Are processes (either formal or informal) in place to review emergency-response performance after completion of emergency operations? *Yes*

*The evaluation process for the EOC begins prior to the storm. Since the South Dakota Highway Patrol (SDHP) are not part of SDDOT, both agencies get on a conference call when a major winter storm is forecasted, along with National Weather Service (NWS) forecasters. Until the storm hits, the conference call is the primary means of communication. As SDDOT is receiving information from the area engineers, it is being shared on the conference call with the SDHP. Once the storm begins, if SDDOT is finding that more urgent action is needed, like closing a section of highway, then a decision might be made to activate the EOC.*

*EOC activations have different levels. For a routine blizzard with only a single section of road closure, and no damaged infrastructure like downed power lines, the EOC will be activated to include the participants of the initial conference call with some DEM staff as well - usually about 12 people at that point. For a major winter event that hits the entire state with more serious impacts like stranded motorists and power outages, a full EOC activation might also include the SD Department of Health, the SD National Guard, and others. Therefore, the level of activation builds dynamically as the emergency builds.*

*SDDOT does not have documentation of the specific personnel included at each level of activation or the specific procedures for each level of activation. However, at the beginning of every winter, all agencies meet and go over what went well last season and anything that has changed to prepare for the coming winter. These meetings also familiarize staff with the group of personnel that will be coordinating emergencies for the coming winter.*

**Is there any documentation to show that the Highway Patrol understands its role relative to the DOT during winter storm emergencies? Do they sign off on the plan?**

*SDHP does not formally review or sign-off on the plan, because they likely have their own internal document that they use to define their role in a winter emergency. Any specific coordination required would come up in the pre-season meeting. For example, SDDOT has a specific procedure for how to consider closing an interstate. Neither SDDOT nor SDHP can do it independently, SDDOT has to control the gates and SDHP sweeps the closed section to make sure no one is "trapped" within the closure. Following the pre-season meeting, plans are updated, if necessary, with information gleaned from the meeting. So that is how SDHP is kept "in the loop" with the SDDOT's plans and procedures.*

**Are there any documented agreements with other states about sharing RSIC resources during an emergency?**

*SDDOT has not had the need to call on out-of-state resources for help during a winter storm in recent memory. The worst storm in recent memory was in 1996-1997, when the National Guard had to be activated and brought some of its equipment to assist SDDOT in maintaining the public roads. Most of the time when SDDOT gets hit with a bad storm that is severe enough to warrant help from adjacent states, those states have been hit too, so resource-sharing is not practical.*

**South Dakota seems to treat the escalation of the resource implementation and shifting as a normal course of events, with the flexibility to adapt a variety of storm intensities. Does resource-shifting**

**between regions within South Dakota happen every winter? Has personnel-shifting been seamless from a human-resources administrative standpoint?**

*As recently as last year South Dakota had a winter storm hit the northwest part of the state and equipment from the southeastern part of the state was moved up to help. It might only be a couple of people or trucks, but it is pretty routine in South Dakota.*

*SDDOT evaluates every storm independently, and will move resources if the storm is only going to affect a specific portion of the state. However, if the forecast is not precise, it might be too risky to move equipment. SDDOT has the resources in each region to provide normal RSIC during routine events, but often need to move large or specialized equipment like snow blowers to where they are needed most.*

*SDDOT has travel policies for staff so it is easy to shift them to a different location temporarily. The travel policies cover hotel stays, per diem, etc. Staff that are shifted report directly to the region they traveled to, so there is no need to have communications between supervisors. Time sheet codes track what routes were served, the equipment used, and how much time was spent, so it is a seamless process.*

**Have any After Action reviews been conducted after a major winter storm emergency, or are any training exercises routinely conducted to prepare for one?**

*In the annual pre-season meeting, lessons learned from the previous winter season are discussed as well as changes or improvements that can be made to the plans. There are also local meetings in each Area, which include local SDHP staff and local maintenance engineers to assess how things went last year. These local meetings often include local sheriffs, city police, and emergency responders as well.*

**Has SDDOT considered incorporating the information in the SDOEM's Winter Storm Risk Assessment (from the 2016 State Hazard Identification Risk Assessment) into this plan? Or contributing the information in its plan to the SDOEM for description of SDDOT's role in response during emergency winter storms?**

*SDDOT has reviewed the information in SDOEM's Winter Storm Risk Assessment to make sure there is nothing to include in SDDOT's plan. In addition, all SDDOT staff have been trained in the Incident Command System, which familiarizes them with SDOEM's procedures. Within the ICS framework, SDDOT understands our specifically prescribed roles and reports to the EOC, which is located at SDOEM. Therefore, once the EOC is activated, SDDOT and SDOEM are fully integrated.*

### 3.1.2 Case Study

#### 3.1.2.1 Define the Issue

**South Dakota is the first state in this study that includes its emergency procedures for winter storms within its plan for normal snow and ice control operations. What is the issue or event that prompted the development of the plan? How long have emergency procedures been a part of the snow and ice control plan?**

*The emergency procedures that are described in the plan have been established since at least as far back as 2010. Prior to 2010, SDDOT had a stand-alone document for emergency management and a stand-alone document for winter maintenance. We found that during a major event, our staff were familiar with the winter maintenance plan but the emergency procedures were not as widely circulated. So it was decided to combine them into one document so staff can get all of the necessary information in one place.*

#### 3.1.2.2 Describe the Background

**What is the history of your agency's activity in this area? How have winter weather emergencies been handled in the past?**

*Public communication has been extremely important for SDDOT, and our successes in handling some of the most severe winter weather storms can be attributed to it. Whenever we know a major winter storm is coming, we let the public know there will be a potential for closures, and we remind them that we have "hours of operation" that are generally from 5am to 7pm. After 7pm, we remind them that driving conditions may be poor, so they should adjust their travel schedules accordingly. By managing the expectations of the driver, we help them make better decisions and they become more tolerant of our operations. Road closures and recommended speed limits are an important way for us to communicate to drivers and change their expectations.*

#### 3.1.2.3 Generate Alternatives/Describe the Proposed Solution

**What are some of the things that your agency can do better? What tools/resources do you need?**

*SD is the lead state for a maintenance decision support system (MDSS) pooled-fund study. In that project, we are working with a vendor to get a 48-hour modeled forecast. MDSS is a product provided by Iteris, Inc. that uses sensors and data gathered from the automatic vehicle location (AVL) in our trucks, combines it with RWIS and other weather data, and makes a recommendation for maintenance supervisors for the coming 24 hours. The idea is to use the recommendation to help inform better decision-making by supervisors. Based on the action our supervisor then takes, the tool incorporates the action taken into the recommendation next time, so the recommendations get smarter. SDDOT is also doing a study to assess whether we should completely build out our AVL connectivity to the entire fleet. Right now only 35% of the fleet has AVL. That study will be completed in March.*

## 3.2 COLORADO CASE STUDY

Kerry Kimble, the Planning Section Chief from the Colorado Department of Transportation - Office of Emergency Management, responded to the initial survey for this project (see sidebar). His response prompted the review of three separate written DOT documents pertaining to emergency-response to extreme winter weather, as well as the statewide all-hazard EOP.

Kerry Kimble participated in a follow-up conference call on November 9, 2017. The results of this interview are presented below, with questions in bold and answers in italics.

### 3.2.1 Follow-Up to Survey Responses: Additional Details

**It looks like CDOT refrains from specifying exact snowfall amounts or intensities to trigger emergency procedures. Is that intentional? In Appendix 1 of the Winter Operations' Conference Call SOP, it looks like the number of Sections affected is a key measure to initiate the call. Is that a key measure of the likelihood of needing to initiate emergency procedures?**

*Initiation of an emergency is part of the conference call, and the measure of severity is roughly the spread of the event, or the number of Sections (regions) being affected.*

**It looks like the Winter Operations' Conference Call would cover communication of CDOT with NWS, then the WebEOC opens up communication with other state agencies. Or is WebEOC only designed to facilitate communication within CDOT? What is the relationship between the Conference Call and WebEOC?**

*When CDOT posts to WebEOC, other state and local agencies can see the post, and we can see their posts. But there is no dialogue on WebEOC - the dialogue occurs in the conference call. For example, shifting of resources between sections would be covered in the conference call. For bigger events, when the state EOC is being activated, the Colorado DEM will initiate*

### COLORADO SURVEY RESULTS

What are the "trigger criteria" for implementing the response plan? *Anticipated / current weather conditions*

Does the plan include specific rules for communication between jurisdictions/agencies to facilitate the response? *No*

Are the roles of each jurisdiction/agency clearly defined? *No*

Are any documented memoranda of understanding between agencies available? *Yes*

Does the plan cover communication between snow and ice control managers and emergency responders? *Yes*

Does the plan call for an agency representative to staff or report to local jurisdiction emergency operations centers? *Yes*

Does the plan specifically address life safety measures necessary for stranded travelers and/or vulnerable residents? *Yes*

How are resources demobilized after the event is over and the response has been completed? *The event coordinator (incident commander) determines need availability. Those no longer needed are returned to their home unit. Documented time and activities are through an internal DOT tracking software program.*

Are processes (either formal or informal) in place to review emergency response performance after completion of emergency operations? *Yes*

Are processes (either formal or informal) in place to collect data to support FEMA disaster declaration and reimbursement requirements? *Yes*

*their own conference call, with a CDOT OEM representative in attendance.*

**Does CDOT expect its snow and ice control resources to be overwhelmed at any time, such that EMACs would be useful? Has help been sought from other states in the past?**

*We have agreements with Wyoming, Nebraska, and Kansas for emergency support, but the only time we've asked for assistance was for the 2013 flood, never for winter storm issues. Resources are moved at the maintenance section level, even for normal personnel leave issues, not only for storm impact issues.*

**What types of training or after-action review does CDOT conduct for winter storm emergencies? How frequently?**

*CDOT does not have a written plan for the after-action reviews. We have meetings and conversations that are dedicated to reviewing our performance, but nothing specifically documented. For example, about 18 months ago CDOT and Colorado State Patrol (CSP) met to informally discuss regional handling of traffic impacts from winter storms at a particular location where this is a continuing problem.*

### 3.2.2 Case Study

Define the Issue / Describe the Background

**What is the issue or event that prompted the development of the plan? How did CDOT come to have an Office of Emergency Management? Other states see that effort led by the emergency management agency. What is the history of your agency's activity in this area? How have winter weather emergencies been handled in the past?**

*In September 2013 Colorado experienced a 24-County flood which impacted 200 miles of highways and damaged infrastructure. That event led to the creation of an OEM at CDOT, which started with 1 person and grew to 4, where it stands currently. Three (3) of the OEM staff came over from the Colorado DEM, which has helped improve coordination between CDOT and CDHSEM. CDOT OEM reports directly to the Deputy Director of the Agency, so they are on the same level as the Division of Highway Maintenance. We are also physically in the same building, same floor as the Division of Highway Maintenance, so that facilitates communication extensively.*

Generate Alternatives

**What are some of the things that your agency can do better? What tools/resources do you need?**

*On a daily basis, we receive information from 4 different NWS stations through a daily weather PowerPoint. When we convene a conference call to discuss a pending storm, the PowerPoint is updated specifically for the call. We probably have 4-5 major winter storms per year that require a conference call.*

Describe the Proposed Solution

**Has CDOT considered a specific plan for reducing/focusing the scope of RSIC to the most critical routes/facilities? Is some of this covered in the Winter Operations Maintenance Plan?**

*No, CDOT has not considered that sort of reduction. The only time something like that might have been considered was in 2006-2007, when Colorado had two blizzards back to back, and Stafford Act (Presidential) declarations resulted for both. The Winter Operations Maintenance Plan is not likely to have that information*.

## 3.3 PENNSYLVANIA CASE STUDY

Jon Fleming, the Division Chief from the Pennsylvania Department of Transportation, responded to the initial survey for this project (see sidebar). His response prompted the review of Chapter 9: *Emergency-Response* of the DOT's Maintenance Manual (PennDOT, 2015), which describes DOT response duties to all severe weather events.

Jon Fleming and Dan Whetzel, PennDOT Maintenance Manager, participated in a follow-up interview on November 8, 2017. The results of this interview are presented below, with questions in bold and answers in italics.

### 3.3.1 Follow-Up to Survey Responses: Additional Details

**What is the relationship between the Publication 23 and the All-Hazards Incident Management Manual – Publication No. 911 and its sister document, Publication 911B?**

*These documents contain only high-level operating guidelines, not specific procedures. Our emergency operations are not checklist-oriented because too many emergency situations require managers to be reactive to what the specific situation calls for. Field foremen and field assistants might make use of a checklist at times, but for the most part they are reacting in a way that we have taught them to react within the concepts laid out in the ICS 300 training. We have PennDOT personnel teach the ICS training so the teacher speaks the language of PennDOT.*

### PENNSYLVANIA SURVEY RESULTS

What are the "trigger criteria" for implementing the response plan (as opposed to treating the weather event as a routine operation)? *Severity of the event - our plan starts prior to a Governor's Declaration*

Does the plan include specific rules for communication between jurisdictions/agencies to facilitate the response? *Yes*

Are the roles of each jurisdiction/agency clearly defined? *Yes*

Are any documented memoranda of understanding between agencies available? *No*

Does the plan cover communication between snow and ice control managers and emergency responders (e.g. police, fire and rescue and regional emergency managers)? *Yes*

Does the plan call for an agency representative to staff or report to local jurisdiction emergency operations centers? *Yes*

Does the plan specifically address life-safety measures necessary for stranded travelers and/or vulnerable residents? *Yes*

Are processes (either formal or informal) in place to review emergency-response performance after completion of emergency operations? *Yes*

Are processes (either formal or informal) in place to collect data to support FEMA disaster declaration and reimbursement requirements? *Yes*

Are there Agencies that you know of that have emergency response plans for extreme winter events? *Our Emergency Management Agency*

*Ultimately, PennDOT's job is to divert traffic during an incident, not to respond to the incident specifically. Occasionally we have road damage to attend to, but we are ultimately at the "back" of the incident, operating in the background.*

**Are there any specific trigger criteria for an emergency winter event? Who makes the call?**

*We have very broad guidelines describing the triggers for an emergency event. The call is made by either the Division Chief, the Deputy Secretary or the Bureau Director. We also have 6 personnel trained to be area commanders, who have the authority to lower the speed limit if the situation warrants. These speed limit reductions are not enforceable, they are guidelines communicated on the variable message boards. We try to be overprotective in issuing speed limit reduction guidelines in an effort to slow the traffic down.*

**Is Appendix D the rules for communication during emergency winter storm events? Are specific contacts and contact info provided anywhere?**

*We have a pre-event weather WebEx before any forecasted severe weather event – flood, snow, tornado, etc.. The engineering districts, county reps, the administration, Federal Highway Administration (FHWA), state police, Pennsylvania Emergency Management Agency (PEMA) and our contract forecaster (AccuWeather) are on the call to discuss the response, and the call follows a script. This happens anytime we expect to have snowfall across 2 or 3 of our geographic areas. Last year, as an example, even though it was a moderate winter for adverse weather, we had 5 or 6 WebEx conferences. The WebEx is where we decide if we will activate our area command. If we do, the affected districts activate their district command centers and a 2-hour reporting interval is initiated. So all parties are checking-in every 2 hours, we are no longer in routine operating mode. The WebEx is also where we discuss moving resources within the state to the regions expected to be impacted more significantly. These practices are not documented in detail anywhere - we follow only a rough set of guidelines for incident management.*

**It looks like PennDOT has been a leader amongst the state agencies in the All-Hazards Planning area. Most other states see that effort led by the emergency management agency. How did PennDOT become the lead agency in all-hazard planning? Has anything been done to ensure that the other agencies shown in the "PennDOT Incident Communication Process" buy-in to this plan? Does PEMA have their own plans that pertain to emergency winter storm events? Are they coordinated with PennDOT's?**

*PEMA is similar to other OEMs in that they are closely tied to the governor's term. So with each new governor's term, the rules for how PEMA operates are rewritten because there is a new administration. So PEMA normally assumes the role of a facilitator, so they can authorize ESF 1 (PennDOT) to take whatever actions necessary during an emergency. Being a Commonwealth, all of Pennsylvania's E911 centers answer to a County-level government, which doesn't necessarily have to answer to the state. As a Commonwealth, we try to govern at the most local level. For transportation purposes, that falls to the County level. So its good that PEMA doesn't dictate specific actions too strongly, but it puts a lot of responsibility on PennDOT's shoulders.*

*Because PennDOT is not a first responder, our PEMA gets the initial call from our County-level 911 centers. Sometimes PEMA hears about the incident before PennDOT. So PennDOT needs a clear line of communication with PEMA. The importance of this communication might come about if a localized incident requires local PennDOT resources but the "push" for that response needs to come from a central PennDOT division. During significant incidents, PennDOT and PEMA co-locate at the statewide traffic management center, which is embedded within the statewide EOC "watch" center. So PEMA, although they don't make decisions for PennDOT, are the first line of communication with PennDOT.*

**Can PennDOT provide a copy of the After Action Review Agenda?**

*Publication 911B has been an internal document, it's very large and includes detailed information about our global detours and other things we would not want to release to the public. [Follow-up request for the After Action Review Agenda was successful.]*

### 3.3.2 Case Study

Define the Issue / Describe the Background

**What is the issue or event that prompted the development of the plan? How did PennDOT become the lead agency in all-hazard planning? Most other states see that effort led by the emergency management agency. What is the history of your agency's activity in this area? How have winter weather emergencies been handled in the past?**

*Before 2007, the ICS did not exist at PennDOT. This type of response planning was very decentralized before then. In 2007, Pennsylvania had a major snow storm that took out 6 interstates and stranded motorists for up to 2 days. During the review of the response to that incident, a lot of the response planning was initiated, and the position of Section Chief was created. After that, PennDOT started changing some of its procedures, especially through the initiation of ICS 300 and 400 training. This year, we have grown to the point where we are hiring new staff in our department.*

*We had enough snow last year to get a Presidential declaration – $19 million of damage over 5 counties and 30 inches of snow in Harrisburg. New York State shut their roads to commercial vehicles, so Pennsylvania had to initiate similar restrictions, with an effective pre-storm communication to commercial trucking companies, including alternate routing suggestions to counties that were not expected to be hit as hard. We considered our response a success because we didn't need to do any full closures, just one interstate closure for less than 2 hours.*

Generate Alternatives

**What are some of the things that your agency can do better? What tools/resources do you need?**

*The 511PAConnects is a tool we got recently, it allows us to "break into" motorists' cell phones to provide information about traffic disruptions that they may be experiencing. The speed limit management decision tree has also been a huge improvement that has helped us, and personnel at PennDOT really like it.*

*[511PAConnect is a trapped-traveler emergency communications tool that allows incident response teams to communicate via automated phone or text message directly with motorists who are trapped in a roadway backup. The tool also gives emergency crews a clearer picture of who is sitting in a trapped vehicle and where they are, so agencies can better plan for the use of resources. 511PAConnect is not a mobile app and requires no initial download or action from motorists. 511PAConnect is only activated during prolonged, emergency roadway stoppages that are expected to last four or more hours. Upon activation, PEMA will send a push message to all phones in the incident area. This message will provide motorists who are impacted instructions for how to participate and receive further information throughout the incident.]*

Describe the Proposed Solution

**Can we get a copy of the speed-limit management decision tree? Can we get a copy of Publication 911B?**

*[Follow-up request for the speed-limit management decision tree was successful.]*

## 3.4 GEORGIA CASE STUDY

Since Georgia did not complete the initial survey, the Georgia EOP was identified during an open search of the literature on this topic. The EOP includes a winter-weather incident annex that provides an overview of how the state coordinates response to significant winter-weather incidents (GEMA/HS, 2016).

Review of this Annex was used to document the basics of GDOT emergency response planning (see sidebar). After an exhaustive search for an individual at GDOT who is most familiar with the plan, a follow-up interview was held with Bryan Haines, the State Emergency Operations Administrator for the Georgia Department of Transportation, on October 30, 2017. The results of this interview are presented below, with questions in bold and answers in italics.

### 3.4.1 Follow-Up to Survey Responses: Additional Details

**The GDOT Winter Weather Procedures dictate staffing the EOC at a Level 1 or Level 2 storm (or, presumably, a Level 3 storm). Is this consistent with the triggers in the Georgia EOP? The Hazard Mitigation Strategy seems to imply that**

### THE GEORGIA EMERGENCY OPERATIONS PLAN

The Georgia DOT response is triggered based on National Weather Service outlooks, advisories, and warnings with a tiered activation process that depends on the time until the storm is projected to arrive.

The plan includes:

- Trigger criteria for implementing a response, based on operational conditions (OPCON) 1 thru 4
- Clearly defined roles for jurisdictions/agencies, including GDOT
- Rules for communication between jurisdictions/agencies to facilitate the response including communication between snow and ice control managers and emergency responders
- An agency representative to local jurisdiction emergency operations centers
- Preparatory actions such as shifting resources between service-areas
- Life-safety measures necessary for stranded travelers and/or vulnerable residents through a multi agency "strike team" structure
- Demobilization procedures after the event is over and the response has been completed

**every winter weather event is treated as severe winter weather, documenting an average of 65 per year since 1940.**

*Since 2014 (and our emergency winter storm), our state agencies have come together statewide better than ever before through our statewide EOC. Once GEMA/HS activates the EOC, all of the agencies are making decisions collaboratively. GDOT is the lead on most of the decisions related to winter storms, and a critical decision is whether to start the brine operation. We have been quicker to make that decision since 2014, and we make it 24-30 hours before the expected impact. For example, we might have 30% confidence that the storm is going to hit, and it might be forecasted to start with rain. We have to be pro-active in that situation with the brine operation because it puts us in control before the storm starts. So we often enter into the brine operation even before the EOC is activated. Especially in the Atlanta area, we are going to be on the conservative side with our response to winter storms.*

**What steps are taken to ensure "buy-in" from all of the agencies mentioned in the plan? Any memoranda of understanding? Do you think the GEMA/HS buys into the GDOT Winter Weather Procedures, and does GDOT buy into the Winter Weather Incident Annex? Was GDOT involved with the developed of the Hazard Mitigation Strategy in 2014?**

*Since 2014, GEMA/HS has been better about holding exercises for the year, like the mid-November winter weather exercise, where we go through the exercise, explaining different aspects of our response. This exercise is better than any paper document because we have to show up, we have to communicate, and we have to acknowledge our roles, in addition to getting practice at actually doing it. So we get buy-in from our various agencies through these types of real-life interactions several times a year, and this supersedes the need to have signature pages or documented approvals.*

**Is the multi-agency "strike team" (Appendix E) solely providing brine and salt truck escort? It seems designed for more than that, as shown on Page 8.**

*We added the brine operation in Georgia after 2014. The strike teams are not a convoy – they are shown that way in the figure only on page 8. They operate along a given section of interstate, each providing the necessary service they are intended for where its needed most. They remain in close radio communication during their response. The Georgia State Police (GSP) escort is there solely as an escort for public safety, and it also helps with the efficiency of the operation. We acknowledge that it's a big request for the GSP escort, because they are also short of resources at a time like this. However, especially in a metro area like Atlanta, if we are out there 24 hours before the event and its 60 degrees and we are brining, the traffic is heavy and drivers don't tend to yield without a GSP escort forcing it. The escort also ensures that the drivers will leave the right amount of safe space around the brining vehicle. The strike teams are critical for winter storms and hurricanes for keeping traffic flowing and responding to any situation that might arise to restrict traffic flow or endanger motorists.*

**Is the plan reviewed and edited on a regular basis, especially with lessons learned following an extreme winter weather event?**

*We are pro-active in trying to enhance our current plan and increase our capabilities. We are constantly trying to increase our fleet for plowing and brining, but that can be difficult when we go a year or two without a significant winter storm. Especially in parts of the state that do not get significant winter storms every year, the case for using resources to be prepared is more difficult to make.*

### 3.4.2 Case Study

Define the Issue

**What is the issue or event that prompted the development of the plan?**

*The 2014 event had a significant influence on our attention to planning. At GDOT, we had been working on the All-Hazards Plan for years. We normally manage our response to emergencies at the more local level, but we were finding that we had to be working toward planning at the statewide level as well, especially as it related to using our resources most wisely – shifting them from places where they were not needed to places where they were needed most. Even so, anytime you experience an event like a hurricane or a snow storm, it serves as a catalyst for enhancing resources for planning. After 2014, the Governor made some decisions that accelerated the planning processes for emergencies.*

*At other agencies in Georgia, it has prompted some changes as well. After 2014, GEMA hired a full-time meteorologist and the NWS in Atlanta was pulled in to work more closely with the state, offering more impact-oriented forecasts instead of simple weather forecasts. GDOT has added 25 more RWIS stations across the state in response to 2014, and engaged in more nationwide data-sharing programs.*

Describe the Background

**What is the history of your agency's activity in this area? How have winter weather emergencies been handled in the past?**

*Prior to 2014, our approach was really agency-specific response planning. After the winter storm in 2014, the approach became more focused on state-response planning, including all agencies cooperatively with GEMA acting as the "holder" of our plans, not allowing them to accumulate dust. Having that one agency dedicated to keeping the plans fresh and working with the ESF leads to keep the personnel trained is critical. Its becoming clearer every year to our governing administration that having full-time people in positions like the State Emergency Operations Administrator at each state agency is critical. The November meeting every year is also a great exercise for keeping things fresh and updated.*

Generate Alternatives

**What are some of the things that your agency can do better? What tools/resources do you need? Does RITIS help?**

*GDOT is trying to bring in a more statewide-level of planning to supplement the current regional procedures. We had some weaknesses in our winter storm plan in the past. We often need to bring resources to Atlanta to help fight problematic winter storms. Prior to 2014, though, personnel that we*

*moved were not always given high-level guidance on their mission. So their work is very reactionary – they wake up in a strange location, get specific instructions, get to work, but then might have those instructions changed an hour later – a very reactionary process. We restructured the way we respond, especially in and around Atlanta, to be more mission-oriented. We now have a process where we can shift resources from the coastal areas down to Atlanta if they are needed, and then give those personnel a specific mission, even down to a segment of interstate that they are fully responsible for.*

Describe the Proposed Solution

**What is HERO? MCCD? GFC?**

*Highway Emergency Response Operators (HERO) is GDOT's highway response unit for metro Atlanta – a multi-purpose vehicle that can service a flat tire, refill gas for a motorist that has run out of gas, tow a stalled vehicle, clear the highway of debris, etc..*

*GFC is Georgia Forestry Commission – they are on the team for control and clearing of vegetative debris, which is a frequent problem during winter storms in Georgia, particularly storms that feature heavy icing.*

*MCCD is the Motor Carrier Compliance Division, which is part of the Georgia Department of Public Safety, and handles heavy truck weight/permitting enforcement.*

**The GEMA/HS plan only seems to specifically cover the interstates. The Winter Weather Procedures describe the priorities for other highways and streets? Are the interstates the only priority that GEMA/HS is concerned about?**

*Most states focus on the interstates in emergencies, and they are the #1 priority in Georgia as well. We try to follow the traffic volume in prioritizing highways to focus on, and volume tends to follow the interstates. In fact, in the past if we had our focus on the interstates and got a call that there was trouble on a smaller multi-lane highway, we would shift our focus to that route. However, we view it now as a mission, so when you pull resources from a mission, you are aborting the mission. In this case, you are going to compromise the interstate and therefore compromise the entire plan, upon which the mission is based. So we try to stick to the mission that's in the plan, so that the more local entities can rely on GDOT's role to be focused on the interstates.*

**Has vegetative debris been a problem on state highways and interstates during severe winter weather? Is there any specification for Multi-Agency Debris Removal Task Forces?**

*We have a lot of pine trees in Georgia – they snap and break easily during winter storms, blocking roads. GDOT can clear downed trees from the road, but its inefficient for us to be stopping our brining operation to handle vegetative debris. So if GDOT encounters a downed tree or debris, we call that Debris Removal task force to respond so we don't have to stop brining.*

**The plan states that the highest probability of winter storms occurs in February, but the highest historical incidence documented by the HMS document is in January since 1940. Has an intensive analysis of historical storms been conducted?**

*No, an intensive analysis has not been conducted. September and October are the big planning months for the winter season. Then January and February are considered the high-risk months, but we are concerned about the other winter months too.*

## 3.5 NEW YORK CASE STUDY

Mike Lashmet, the Snow and Ice Program Engineer for the New York State Department of Transportation, responded to the initial survey for this project (see sidebar). His response prompted the review of the NYSDOT Emergency Transportation Operations Playbook (NYSDOT, 2016), which governs NYSDOT response to severe winter weather emergencies, as well as the New York State Hazard Mitigation Plan, which provides an extensive summary of historical storm events.

Mike Lashmet, Joe Thompson (Assistant Program Engineer for Snow and Ice), Rita Carlson (Emergency Transportation Operations Director), Matt Vasilow (Assistant Emergency Transportation Operations Director), and Jennifer Hawkins (Acting Bureau Director) participated in a follow-up interview on November 27, 2017. The results of this interview are presented below, with questions in bold and answers in italics.

### 3.5.1 Follow-Up to Survey Responses: Additional Details

**How is communication with the specific agencies on page 2-8 conducted? Do other agencies look at SEERT? Does information go from the DOT to NYResponds, or is SEERT linked to NYResponds?**

*No other agencies can see SEERT, only NYSDOT. The AVL feed on our truck locations can be seen by the Thruway*

### NEW YORK SURVEY RESULTS

What are the "trigger criteria" for implementing the response plan? *Governor's Declaration, DOT Management, and Local Declaration*

Does the plan include specific rules for communication between jurisdictions/agencies to facilitate the response? *Yes*

Are any documented memoranda of understanding between agencies available? *Yes*

Does the plan cover communication between snow and ice control managers and emergency responders? *Yes*

Does the plan call for an agency representative to staff or report to local jurisdiction emergency operations centers? *Yes*

Does the plan specifically address life safety measures necessary for stranded travelers and/or vulnerable residents? *No*

How are resources demobilized after the event is over and the response has been completed? *All deployed personnel and equipment are tracked through an in-house system. As missions are completed, crews are usually demobilized intact as initially deployed. Crews generally remain overnight to rest up before traveling back to home base. Equipment is all checked out and serviced before the return trip. The in-house system then tracks the departure date and time of each individual and then records arrival date and time back to home base, to be sure all personnel are accounted for. Equipment is rechecked soon after arrival at home base.*

Are processes (either formal or informal) in place to review emergency response performance after completion of emergency operations? *Yes*

Are processes (either formal or informal) in place to collect data to support FEMA disaster declaration and reimbursement requirements? *Yes*

*Authority through an ArcGIS SnowCOP (Snow Common Operational Picture) viewer. NYResponds is where requests will come in to a common location from Counties and towns when they are overwhelmed, and those requests are routed to the appropriate ESF, in our case ESF 1. NYResponds is where the agencies all get to see a common picture. There are different access levels in NYResponds, though, it is a "rebranded" form of DLAN. So if a state agency needs help during an emergency, they generally support each other and they may go through this system, depending on the situation. Only locations of the trucks and the locations of the requests are geocoded in NYResponds – it's a completely different system from SEERT. We are developing a Winter Operations APP to serve as a central viewer for live data but that is not completed yet.*

*In the last few months, NYS developed a disaster-preparedness asset tracker, which tracks NYSDOT assets and other state agency assets (beyond the Thruway and NYSDOT) that can be deployed in any type of emergency. Most of the state's assets are NYSDOT assets but others are there too. The tracker is an app on a tablet that includes all of the information on the asset – photo, location, description.*

**Do the agencies listed on page 2-8 sign off on this plan?**

*We have frequent meetings with the other agencies listed, they have a copy of the Playbook, but there are not any signature pages or memoranda of understanding (MOUs) attesting to their understanding of their roles. Their comments and feedback were not solicited before the 2016 update.*

**How does NYSDOT communicate with state and local police during a winter emergency? Is it important for NYSDOT to be aware of, and responsive to, life-safety situations during emergency winter storms? Life-safety efforts include state police and emergency-responders' efforts to rescue stranded motorists and residents statewide, while continuing to provide normal police, fire, and ambulance response activities.**

*We work with state police frequently on closures. If we are considering closing a road, the state police, the NYSDOT Commissioner, OEM, and the Governor's Office are all involved. Sometimes that process might play out on the local level before the information never gets up to NYResponds, but in the case of major winter storm where we might have stranded motorists, that decision will be elevated to the level where all agencies are involved and coordinated through NYResponds so there is not only a closure but a response within the closure. NYSDOT is not typically involved in rescue or specific response within a closure, although we might be involved on the ground when it comes to instituting something like a tractor-trailer ban.*

**The Playbook contains good information about After Action reviews, but is there also a regular (annual or biennial) meeting to discuss lessons learned, preparations, and/or modify the plan?**

*The regions have snow and ice kickoff meetings every year, led by the regional engineers. The Fall meeting includes a discussion about operational safety for the changeover of equipment from summer work to winter work. Issues pertaining to snow and ice maintenance and operations are also discussed. Those meetings occur at the more granular level. At the system level, there is continuous training and drilling so there is no need for an annual meeting. We do at least one statewide drill per year and regions*

*can do their individual drills as well – those are coordinated through the regional emergency management offices. NYResponds always contains active events, so it's a tool that is active and used continuously.*

### 3.5.2 Case Study

Define the Issue

**NYSDOT's plan seems to be at leading edge of the practice. Was there an issue or event that prompted the development of the plan?**

*The playbook was originally put together in 2015. Prior to that, we had our plan for how to deploy resources, we made phone calls, but we never had anything officially documented. Our Commissioner got the ball rolling to make sure that everything was documented. An important result of this process of documenting the procedures is that it will survive changes in senior leadership.*

Describe the Background

**What is the history of your agency's activity in this area? How have winter weather emergencies been handled in the past?**

*We have improved our ability to account for our assets. In the past, we had a more ad hoc way of tracking resources – consisting of things like passing around Excel spreadsheets. One of the big recent improvements was to automate that process, using the SEERT tool, and using AVL which is provided by Verizon. This allows us to see the dynamic status of our emergency equipment. For snow and ice, we have a storm operations status that is updated manually every 2-8 hours during a storm.*

Generate Alternatives

**What are some of the things that your agency can do better? What tools/resources do you need?**

*Our After Action Reviews pertaining to winter weather have concluded that getting early and frequent communication and messaging out to the public before a storm is most effective for reducing impacts. The messaging typically pertains to restrictions that will be in place, and that travel is discouraged during certain times. We can improve our planning for how we close specific road segments, especially where ramps are included. We can also coordinate better with other states where closures or restrictions might impact their traffic.*

Describe the Proposed Solution

**Is Appendix I finalized yet?**

*The different types and rates of precipitation that appear in Appendix I were just a place to start for us to begin considering risk and impacts from different storm intensities. Since these are just "guidelines" and they use ranges of intensity, we did not want to call it "final" and tie our hands when it comes to being flexible regionally. NWS has better risk levels that correspond to different intensities, but are sensitive to*

*different regions in the state – 2 inches an hour upstate will not have as adverse an impact as that same rate of snowfall on Long Island.*

**Can you explain the Critical Response Segments in Appendix J?**

*They pertain to the priority "beats" for maintenance during emergency winter storms – they are not the same beats we use for normal snow and ice maintenance. We use these beats as a reference for determining whether we will need to move resources in order to prioritize maintenance. "Residences" are the DOT shops, which generally have responsibility for the County where they are located. Priority A beats are system-critical locations in red, blue are municipal responsibility, and the rest are green. Priority A roads were determined by senior leadership in the region to be system-critical, so the focus is to decrease the cycle times on those highways if you are receiving supplemental resources. Priority B roads come into play if a Priority A road is closed, then the Priority B road becomes system-critical.*

**Can you explain the "1/3 Fleet" concept for resource-shifting?**

*It is the level to which equipment and staff from one location can be reduced if they are needed elsewhere, or to compensate for an extraordinary situation such as flu or pandemic, allowing for a minimum acceptable level of service – essentially creating a "bullpen" for each shop. Most of the time, for winter storms, assets are being shared from upstate to downstate to create a smaller cycle time, so this is the level that we do not let those upstate shops fall below.*

## 3.6 MICHIGAN CASE STUDY

Since Michigan did not complete the initial survey, the Michigan Emergency Management Plan (MEMP) (MSP/EMHSD, 2016) and the Michigan Hazard Mitigation Plan (MHMP) (MSP/EMHSD, 2014) were identified during an open search of the literature on this topic. The MEMP includes a disaster-specific procedure for severe winter weather and the MHMP provides risk analysis information specific to winter weather.

Review of the MEMP was used to document the basics of MDOT emergency response planning (see sidebar). After an exhaustive search for an individual at MDOT who is most familiar with the plans we reviewed, a follow-up interview was held with Eileen Phifer, Safety and Security Administrator for the Michigan Department of Transportation, on November 20, 2017 in order to ask follow-up questions. The results of this interview are presented in the two subsections below, with questions in bold and answers in italics.

### THE MICHIGAN EMERGENCY MANAGEMENT PLAN

The MEMP can be triggered by a FEMA Declaration, a Governor's Declaration or a Local/County Declaration.

The plan includes:

- Specific role for MDOT as lead agency of the Public Works and Engineering ESF, concerned with issues pertaining to incident related damage and impacts to critical public facilities and infrastructure, including the transportation, communications and energy distribution networks
- Rules for communication between jurisdictions/agencies to facilitate the response
- General processes to review emergency response performance after completion of emergency operations

### 3.6.1 Follow-Up to Survey Responses: Additional Details

**Is any additional information on MDOT's role in maintaining roads during an extreme winter storm available, like a plan for normal snow and ice control operations?**

*Michigan has a number of plans that apply to extreme winter storms, there are multiple levels of response, and each level gets more detailed. The MEMP is very high-level plan. The MEMP is at the statewide level, and discusses the protection of life and property. MDOT works closely with MSP, who is the holder of this document, but the author of the document is all state agencies. All agencies have the opportunity to comment on all sections of the MEMP, even the sections that don't apply to their role as an ESF. The state also has a very specific business continuity plan (BCP), which relates to the continued function of the state agencies during emergencies, to ensure that they keep operating. We also have a department-wide plan within the BCP, which discusses the mission-essential functions of MDOT, including snow and ice control.*

*Most of the specifics regarding snow and ice control are in MDOT's plan for normal snow and ice control operations, which is held by Maintenance Services. We look at snow and ice control as a subset of debris removal in general. [Follow-up requests for MDOT's snow and ice control plan were successful.]*

**The plan contains information about petitioning FEMA for a major disaster (not an emergency) declaration, but these determinations pertain to assessments made during or after the storm, according to, for example, snowfall totals. What are the procedures used to determine if an emergency exists and the EOC should be activated? At what point are MDOT staff called on to interact with, or report to, a local or state EOC?**

*There is a very prescriptive way to reach EOC activation. Severe weather events start at the local level, affecting local roads. If a local entity is having trouble with maintenance of its roads in a winter storm, MDOT will work with the local road commission and MSP/EMHSD. Some road commissions are under a County umbrella, so the County entity might also be involved. Most of our Counties have a pre-existing contract with MDOT to work on their roads since they are not normally MDOT's responsibility. Once they notify us that their resources are being overwhelmed, we will have them notify their local emergency management coordinator, who then brings it up to the district emergency management coordinator, who then brings it up to the state level – the MSP/EMHSD are notified. At that time, either the EOC would be opened or a virtual activation would be initiated.*

**After-action reporting is mentioned on page 11, but very few details are provided for the after action review. Are these details, or a framework for after-action reviews, provided elsewhere?**

*A couple of years ago, a snow squall created a 100+ car pileup including chemical spills and fireworks on a major highway from Detroit to Chicago. A very busy section of highway had to be closed for 48 hours. It didn't escalate to a Governor's declaration because it was fairly localized. Costs had to be recovered for all of the different response entities. After it was cleared and the road re-opened, a contractor was hired to do an after-action review of all response activities, due to the costs of the incident. [Follow-up requests for the contractor report on this after-action review were unsuccessful.]*

### 3.6.2 Case Study

Define the Issue

**What is the issue or event that prompted the development of the plan?**

*In 2004, there was a FEMA-level emergency for a snow storm. Approximately every 3-4 years there is a major winter storm. Other storms have been substantial where state offices had to be closed. State police have more information on the history of major storms and the hazard analysis.*

Describe the Background

**What is the history of your agency's activity in this area? How have winter weather emergencies been handled in the past?**

*A couple of years ago, a snow squall created a 100+ car pileup including chemical spills and fireworks on a major highway from Detroit to Chicago. A very busy section of highway had to be closed for 48 hours. It didn't escalate to a Governor's declaration because it was fairly localized. Costs had to be recovered for all of the different response entities. After it was cleared and the road re-opened, a contractor was hired to do an after-action review of all response activities, due to the costs of the incident.*

Generate Alternatives

**What are some of the things that your agency can do better? What tools/resources do you need?**

*We would expect this learning to be happening at the local or regional level, since the local and regional authorities have more detailed responsibilities.*

Describe the Proposed Solution

**Reference is made to a "trunkline" system of roadways. Is there a more detailed description of the "trunkline" system?**

*The trunkline system is the state-maintained system – interstates, federal highways, and state highways. We have a set of procedures for closing a trunkline roadway that we developed over several years jointly with the MSP into a EHTRP and road closure plan, but its not a public document. [Follow-up requests for the EHTRP were unsuccessful.]*

## 3.7 I-95 CORRIDOR COALITION REVIEW

The I-95 Corridor Coalition is an alliance of transportation agencies, toll authorities, and public safety agencies, from the State of Maine to the State of Florida that provides a forum for key decision- and policy-makers to address transportation management and operations issues of common interest. In order to investigate the potential opportunities offered by this type of collation, a series of questions were asked via email of Denise Markow, who is the coalition's Coordinated Incident Management and

Safety Committee chair. She recommended reviewing the resources available on the I-95 CC's website on this topic:

- The I-95 CC worked with seven New England Regional Area States – Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, and eastern New York – to hold a Meteorological Winter Operations Regional Conference on September 24, 2014 in Boston. The conference goal was to determine a path to better storm management and information coordination in the New England Regional Area, and brought together the seven states' Agency Traffic Operations/Traveler Information and Maintenance personnel responsible for operations during winter meteorological events.
- The I-95 CC held another conference on May 12-13, 2015 in Linthicum, Maryland to share information on response to all types of "significant events". Of primary interest for emergency response planning for extreme winter weather were the materials from the following presentations at that conference:
    - "The Multi‐Level Approach," Denise Markow, Administrator, Bureau of Transportation Systems Management and Operations, New Hampshire DOT
    - "Aggressively Making the Call – to Travel or Not to Travel," John Hibbard, Operations Division Director, Georgia DOT
    - "Coordinating Traffic Incident Management Response & Responders," Jennifer Portanova, State Systems Engineer, North Carolina DOT
    - "Responding to Forecasted Significant Events – The Boston Blizzard," Scott Wilson, Director of Roadway Operations, Highway Division, Massachusetts DOT
    - "I-95 Corridor Coalition Regional Integrated Transportation Information System and Collaborative Decision Tool," Michael Pack, I-95 Corridor Coalition/Director, University of Maryland Center for Advanced Transportation Technology
    - "Truck-Mounted, Remote‐Controlled Video Cameras for Significant Events," Rick Dye, Statewide Systems Administrator‐CHART, Maryland State Highway Administration
    - "A Snapshot of New York State DOT's Emergency Response Tools," Christine Klein, Regional Emergency Manager, New York State DOT
    - "Emergency Management Assistance Compact – The State DOT Perspective," John Scrivani, Assistant Division Administrator, Virginia DOT‐Operations Division

Many of the materials contain information of value to states and municipalities in preparing or enhancing a plan for emergency response to extreme winter weather. Both lessons learned and expected best practices are covered, and many of these practices were also discussed in the interviews and case studies documented above.

The role of I-95 CC as an information resource, and as a forum for data sharing amongst its members has resulted in the creation of the Regional Integrated Transportation Information System (RITIS), which allows its users to see data from other users' states or municipalities. Several of the interviewees for this project make use of the RITIS as a data-sharing resource for winter weather planning already. The

Metropolitan Washington Council of Governments (MWCOG) appeared to be at the forefront of this type of use of RITIS, but in the survey for this project, our Maryland DOT rep for Clear Roads did not indicate that Maryland had a formal strategy for dealing with winter weather emergencies. Further efforts to contact a representative at MWCOG for further clarification were unsuccessful.

Since the I-95 CC's historical role has been oriented solely toward information- and data-sharing, the following question was asked:

**Has the I-95 CC ever considered facilitating actual cross-jurisdiction agreements for resource-sharing during extreme weather events? This would mean that the I-95 CC would become more than a forum for information-sharing, but an actual facilitator, possibly even a holder of signed agreements between agencies.**

*We have not done anything like that to date but this coming January [2018] we are facilitating an exchange between the Southern states and their response strategies to Hurricane Irma - so there may be an opportunity to develop this type of initiative starting in the South.*

# CHAPTER 4: BEST PRACTICES AND RECOMMENDATIONS

This chapter covers the recommendations and best practices distilled from the six interview-based case studies described in Chapter 3. This set of recommendations is a synthesis of the best practices and lessons learned that were common to multiple case studies. These best practices provide a framework for the creation or updating of a written emergency response plan for extreme winter storm events. Best practices are included if they are widely transferable, meaning that they are useful for any state or municipality in developing or refining their approach to planning for emergency response to severe winter weather. Practices or approaches that are specific to certain regions or DOTs and are less transferable to other agencies are not included as best practices. Recommendations fall into the following categories:

- Organization & Communication
- Planning, Training, and Review

For each category, the recommended best practice is listed, followed by testimony of that practice from the interviews and the literature review (in italics).

## 4.1 ORGANIZATION & COMMUNICATION RECOMMENDATIONS

Clear, well-understood organizational-structure and communication-procedures are fundamental to an effective emergency-response. These fundamentals ensure that emergency-response procedures are comprehensive, consistent, and reliable. Without a clear governing structure, emergency operations are vulnerable to missed information, contradictory decision-making and other pitfalls.

### 4.1.1 Best Practice: DOT Office(r) of Emergency Management

An Office (or Officer) of Emergency Management within the DOT, independent of the state's Department of Emergency Management (DEM, separate from the DOT), is a cornerstone of successful emergency operations. The OEM functions as the organizing hub of emergency response and has the authority to activate a DOT-specific EOC without a statewide activation. The DOT's OEM should include one or more officers who have experience in emergency management but work closely with highway maintenance and operations personnel. FEMA's ICS provides a common organizational framework for states to follow when launching an OEM.

*All of the interviewees were affiliated with their DOT's emergency-management office or instrumental in its emergency-response function. All of these offices, departments, and staff positions were created or resourced within the last 5 to 15 years, as attention to emergency-response planning has increased nationwide. Each of the states interviewed had between 1 and 6 personnel in the office, department, or section responsible for emergency management at the DOT.*

*Emergency management staff from the South Dakota, New York, Michigan and Pennsylvania DOTs primarily have a background in maintenance at the DOT, but also have experience with emergency*

*management and emergency response. Emergency management staff from Colorado and Georgia DOTs have primarily an emergency management background, but now work for their DOTs in its formalized OEM. Both of these organizational approaches appeared to be successful.*

*ICS structure, training, and principles have been implemented in several states to support emergency management functions. At PennDOT, the implementation of the ICS structure since 2007 has centralized the coordination of response to emergency winter storms – the position of Section Chief was created and widespread ICS 300 and 400 training was initiated. PennDOT personnel teach the ICS training, which makes the material more effective than using outside personnel. New York State DOT specifies ICS training levels (100 to 400) and ICS organizational assignment for every regional employee. Three regions in New York have full-time dedicated Regional Emergency Managers (REMS) and eight regions have part-time REMs with shared responsibilities in other program areas. Colorado DOT's response structure recognizes ICS and CDOT's place in that system.*

*After the 2014 storm in Georgia, the Governor accelerated the planning process for emergencies. The Georgia Emergency Management Agency (GEMA) hired a full-time meteorologist and the NWS in Atlanta began to work more closely with the state agencies, offering impact-oriented forecasts instead of simple weather forecasts. The response approach became more statewide, including all agencies acting cooperatively with GEMA as the "holder" of the plans.*

### 4.1.2 Best Practice: Pre-Event Structured Conference Calls

Convening a conference call, with a documented agenda and participant list, whenever a significant winter storm is forecasted promotes successful planning and execution of emergency operations. The call facilitates information-sharing and collaborative decision-making for significant events, like activation of the DOT's EOC, travel bans, highway restrictions, and messaging on variable message signs. Major decisions, like activation of the DOT's EOC should be communicated to the statewide OEM. Including members of the DOTs of neighboring states on the call ensures that any major decisions like travel bans will be coordinated for cross-border traffic and prevent miscommunications that might arise from more indirect communication from multiple sources.

*South Dakota DOT (SDDOT) initiates a conference call with the South Dakota Highway Patrol (SDHP) and forecasters from the NWS whenever a major winter storm is forecasted. Leading up to the onset of the storm, the conference call is the primary means of communication. For a major winter event that hits the entire state with more serious impacts like stranded motorists, closed roads, and power outages, a full EOC activation might also include the Department of Health, the National Guard, and others.*

*CDOT specifies a Winter Operations' Conference Call Standard Operating Procedure (see Attachment A), where emergency procedures are considered collaboratively with NWS. The number of sections (districts) expected to be affected by a storm is a key measure in considering the initiation of a conference call. In addition to the Winter Operations Conference Call, CDOT uses WebEOC to manage information flow. WebEOC is a hosted, web-enabled tool to support crisis management, public safety and emergency response personnel, by providing simplified access to information that allows other state and local*

*agencies to get updates on CDOT's actions. CDOT can see posts from other agencies, but there is no dialogue on WebEOC. If the statewide EOC is activated, the Colorado Department of Homeland Security and Emergency Management will initiate their own conference call, with a CDOT OEM representative in attendance and multiple agencies in dialogue.*

*PennDOT convenes a conference call before any forecasted weather event that is expected to affect more than 1 or 2 of the state's districts. The call includes engineering districts, county reps, administration, FHWA, state police, Pennsylvania Emergency Management Agency (PEMA) and PennDOT's contract forecaster. It follows a predefined script to ensure that all essential decision points are covered.*

*When an event is expected, NYSDOT holds a minimum of two conference calls a day to cover all areas of DOT response. The initial conference call outlines potential hazards, regional and main-office readiness levels, agency policies regarding event-specific activities, and additional expectations from department executives (such as the Commissioner's or the Governor's offices).*

*During major events, TRANSCOM convenes pre, during, and post conference calls with stakeholders including neighboring states and those in the coalition.*

*Interviewees reported forecasted storms requiring the convening of a conference call, on average, 4 to 7 times each winter season.*

### 4.1.3 Best Practice: Public Communications Plan

A public communications plan ensures that the public is well informed about expected road conditions, speed reductions and other information and is valuable for adjusting drivers' expectations for the coming storm. The plan should include outreach mechanisms (e.g. traditional and social media) and specific communication strategies for schools and major employers. Variable message signs can also be an excellent way of communicating directly with the travelling public.

*Public communication ensures success in handling severe winter storms for SDDOT. Whenever SDDOT knows a storm is coming, the public is alerted that there will be a potential for closures, and reminded that SDDOT has "hours of operation", generally from 5am to 7pm. Outside of these times, driving conditions may be poor, so they should adjust their travel schedules accordingly. By managing the expectations of the driver, SDDOT helps them make better decisions and become more tolerant. Road closures and recommended speed limits also communicate indirectly to drivers to change their expectations.*

*NYSDOT has concluded that getting early and frequent communication and messaging out to the public before a storm is the most effective way to reduce its impacts. Messaging should include specific travel restrictions but should also discourage travel in general during a certain period of time.*

*PennDOT can also use 511PAConnects to "break into" motorists' cell phones to provide information about traffic disruptions that they may be experiencing. 511PAConnect is a trapped-traveler emergency*

*communications tool that allows incident response teams to communicate via automated phone or text message directly with motorists who are trapped in a roadway backup. The tool also gives emergency crews a clearer picture of who is sitting in a trapped vehicle and where they are, so agencies can better plan for the use of resources. 511PAConnect is not a mobile app and requires no initial download or action from motorists. 511PAConnect is only activated during prolonged, emergency roadway stoppages that are expected to last four or more hours. Upon activation, PEMA will send a push message to all phones in the incident area.*

### 4.1.4 Best Practice: Extensive RWIS and AVL Coverage

Up-to-date, real-time information is essential for effective emergency operations. Widespread coverage of RWIS and AVL systems on all RSIC vehicles and equipment enables asset-tracking before and during a storm. This tracking allows efficient re-allocation of resources and effective communications with the public about the conditions of roads and the status of RSIC operations.

*Most of the interviewees were working toward having 100% of their RSIC vehicles and equipment outfitted with AVL or similar technology, and adding RWIS stations each year to increase the coverage of road-weather information. GDOT added 25 more RWIS stations across the state in response to the 2014 emergency, and engaged in more nationwide data-sharing programs. NYSDOT has also installed GPS units on crucial items such as generators, light towers and sandbaggers for improved asset-tracking. This location data will be incorporated into the new NYResponds software, which will be complemented by real-time weather forecasting and modeling through the New York State Early Warning Weather Detection System.*

### 4.1.5 Best Practice: Regional Coalitions

Regional coalitions provide an information- and data-sharing role to allow their member agencies to learn from one another through workshops, summits, conferences, and enterprise data platforms. Regional coalitions can also foster communication between the DOTs of neighboring states, to ensure that any major decisions like travel bans are coordinated for cross-border traffic.

*The I-95 Corridor Coalition provides information of value to states and municipalities in its membership for preparing or enhancing plans for emergency response to extreme winter weather. Lessons learned and best practices are discussed. The role of I-95 CC as an information resource, and as a forum for data sharing amongst its members has resulted in the creation of the Regional Integrated Transportation Information System (RITIS), which allows its users to see data from other users' states or municipalities. RITIS integrates existing data from transportation and public safety systems, the private sector, and the military. The data is fused and then disseminated to credentialed users through interactive websites.*

*Another regional coalition that serves a similar role is TRANSCOM, a coalition of 16 transportation and public-safety agencies in the New York – New Jersey – Connecticut metropolitan region. One of TRANSCOM's roles is to be a repository and distribution point for data exchange between member agencies. TRANSCOM also supports regional technology efforts such as integrated corridor management*

*and active traffic management initiatives. Similar to the RITIS is TRANSCOM's Data Fusion & Analysis Tools, which collect real-time and historical information from agency and private data sources about disruptive incidents and events, travel times, transit vehicle locations, and stop arrival/departure times. It generates a standardized aggregated regional view of roadway and transit conditions every 2 minutes.*

## 4.2 PLANNING, TRAINING, AND REVIEW RECOMMENDATIONS

The planning, training and review processes are essential to developing and maintaining a written emergency-response plan that is effective and integrated into DOT operations. The planning and training components ensure that a DOT works out the details of its response in advance of an event, and ensures that personnel are aware of their specific responsibilities. This planning process also provides an opportunity for a variety of partners to provide input, ensuring that it will be acceptable for all of the related sections within the DOT, and for other agencies involved like state police. A formalized review process makes the emergency plan a dynamic document that is updated to reflect changes in resources and staffing and to reflect new lessons learned so that the plan remains useful of time. An up-to-date written plan with details of an agency's practices and procedures also provides continuity of operations as personnel turn over through the years.

### 4.2.1 Best Practice: Scalable RSIC Operations Plan

The ability to adjust RSIC operations in response to extreme weather is the core of emergency response. Scaling RSIC operations is especially challenging since equipment and personnel levels are relatively fixed in the short-term. Scalable RSIC operations plans should include adjustments to the normal RSIC routes (at a minimum, interstate routes), personnel work adjustments (e.g., overtime/split-shift policies), resource-shifting guidelines, and procedures or agreements in place to expedite requests for external assistance. Ensuring wide circulation of the plan within the DOT, the DEM, and the state police is essential – affirming this circulation/review with a signature sheet ensures "buy-in".

*South Dakota, New York, Georgia, Pennsylvania, and Colorado have active plans for emergency response to extreme winter weather that each feature elements at the leading edge of the practice:*

- *SDDOT, 2016. South Dakota Department of Transportation: Winter Highway Maintenance Plan, 2016-2017. Prepared by Greg Fuller, Director of Operations and Jason Humphrey, Construction and Maintenance Engineer, South Dakota Department of Transportation, October 2016.*
- *NYSDOT, 2016. Emergency Transportation Operations Playbook, Produced by the New York State Department of Transportation. Revised October 2016.*
- *GEMA/HS, 2016. Winter Weather Incident Annex : Annex S - Georgia Emergency Operations Plan. Produced by the Planning Section of the Georgia Emergency Management and Homeland Security Agency, 9/7/2016.*
- *PennDOT, 2015. Chapter 9: Emergency Operations. From the Bureau of Maintenance and Operations Maintenance Manual, Publication 23 of the Pennsylvania Department of Transportation, Updated 4/15.*

- *CDOT, 2017. Colorado Department of Transportation Emergency Operation Plan. Produced by the Office of Emergency Management, Department of Transportation, October 2017.*

*These plans were created, formalized, or enhanced in the last 10 years, as attention to emergency response planning more generally has improved nationwide. The development of these plans has institutionalized a set of processes that were previously more informal and decentralized. The administrative locations of these response plans vary. South Dakota's plan is within its snow and ice control operations plan, held by the operations and maintenance staff. Others were in a stand-alone, DOT-issued emergency response plan, held by the DOT's emergency management staff. Michigan keeps only an All-Hazards Plan with a winter-storm incident annex that is held by the Michigan Department of State Police. This approach is more typical in states that do not have full-time emergency management staff within the DOT.*

*SDDOT will move resources if a storm is only going to affect a specific portion of the state and the forecast is certain. Large or specialized equipment like snow blowers are frequently moved where they are needed most. SDDOT has travel policies in place for staff to facilitate a temporary move to a different location covering hotel stays and per diem. SDDOT's emergency procedures are incorporated into its plan for normal snow and ice control operations.*

*South Dakota and Colorado have not had the need to call on other states for support in responding to a severe winter storm.*

*Georgia uses a "strike-team" approach in its response to emergency winter weather events. For a state where winter-weather emergencies can arise from lower-intensity storms with more ice and less snow, this approach works best. The teams operate along an assigned section of interstate, providing a complete array of the necessary services – brining, vegetative debris removal, towing, rescue, and state police response. The team members remain in close radio communication during their response and the state police provide an escort to enhance the efficiency of the operation, as drivers may not yield or keep a safe distance without the escort.*

*NYSDOT's Critical Response Segments are mapped priority "beats" for maintenance during emergency winter storms – these "beats" differ from those used for normal snow and ice control. Priority A are system-critical locations, determined by senior leadership in the region, and the focus is to decrease cycle times on those highways if you are receiving supplemental resources. Priority B roads come into play if a Priority A road is closed, then the Priority B road becomes system-critical.*

*NYSDOT's "1/3 Fleet" concept dictates the level to which equipment and staff from one location can be reduced if they are needed elsewhere – essentially creating a "bullpen" for each shop. Most of the time, for winter storms, assets are being shared from upstate to downstate to create smaller cycle times NYSDOT does not let any shop fall below the "1/3 Fleet" minimum.*

*Michigan's Emergency Management Plan only covers the protection of life and property at a high level during a winter weather emergency. Michigan Department of State Police is the holder of the document,*

*but all agencies have the opportunity to comment on all sections of the MEMP, even the sections that do not apply to their role as an ESF.*

### 4.2.2 Best Practice: Legal Authority for Road Restrictions

During the most extreme winter-weather events, restrictions on road usage may be required to facilitate snow removal and maintain motorist safety. Legal authority for these restrictions should be well established in advance. In coordination with state police, DOT authority to reduce speed limits and/or close sections of its highway network can be used to protect the safety of the traveling public. These abilities should be clearly defined and enforceable through state legislation. Exceptions to road closures should also be noted, including DOT snow and ice control vehicles, emergency response vehicles, and critical shippers like salt and fuel oil haulers.

*PennDOT manages its decisions to restrict or close highways with a multi-level decision tree (Attachment B). SDDOT interstates feature a system of gates and a specific procedure for how to consider closing an interstate segment. Neither SDDOT nor SDHP can do it independently – SDDOT has to control the gates and SDHP sweeps the closed section to make sure no one is "trapped" within the closure. NYSDOT works with state police frequently on closures. When a road closure is being considered, the state police, the NYSDOT Commissioner, the New York State Office of Emergency Management, and the Governor's Office are all involved.*

*Although Vermont was not selected for one of the case studies, the Vermont Agency of Transportation (VTrans) publishes an Emergency Transportation Operation Plan (VTrans, 2015) which includes a detailed Memorandum of Understanding (MOU) between VTrans and the Vermont Department of Public Safety (State Police) regarding the emergency closure of state highways. The MOU is included as Attachment C.*

### 4.2.3 Best Practice: Threat Identification and Assessment

Planning for extreme winter weather requires a clear understanding of the magnitude of "worst case" winter weather. Failure to undertake periodic threat assessments can leave agencies unprepared for these worst-case events. Conducting a threat identification and assessment ensures that a full range of scenarios can be incorporated into the emergency-response plan for extreme winter weather. Threats described should include type, monthly frequencies, and geographic frequencies (by district).

*None of the plans reviewed for this project included a comprehensive threat identification within their written emergency response plan. NYSDOT documented the types and rates of precipitation to consider as general guidelines for risk and impacts. They defer to NWS for information about risk levels that correspond to different storm intensities, and are sensitive to different regions in the state. Most of the states have a separate all-hazards plan that includes a threat identification and assessment. New York State's threat identification and assessment pertaining to winter storms, within its Hazard Mitigation Plan (produced by the Division of Homeland Security and Emergency Services), is at the leading edge of the practice (Attachment D).*

### 4.2.4 Best Practice: Formalized Training and Review

Emergency operations plans are only effective when they are frequently updated and broadly disseminated to stakeholders. Formalized training and review protocols help keep response plans up-to-date and integrated into agency practice. Established review protocols for emergency winter operations should including an annual or biannual winter operations meeting, after-action reviews following an emergency winter storm, and annual circulation, review and update of the written plan. Ongoing discussions between the DOT's EOC and the state EOC will help understand the requirements necessary for statewide EOC activation and if the DOT is included in the decision.

*At the beginning of every winter, all SD agencies meet and review what went well last season, as well as anything that changed since last season to prepare for the coming winter and to familiarize themselves with the personnel that will be coordinating emergencies in the coming season. The pre-season meeting allows everyone to discuss lessons learned from the previous winter season. There are also local meetings in each district, which include local highway patrol staff and local maintenance engineers. These local meetings can involve local sheriffs, city police, and emergency responders as well.*

*GEMA/HS convenes a mid-November winter weather exercise – participants show up, communicate, acknowledge roles, and practice the response. "Buy-in" from the various agencies comes through these in-person exercises.*

*NYS also conducts periodic drills of simulated situations which involve the state EOC and various state agencies. This forum helps identify and plan for worst-case winter events and other situations (mass casualty incidents, nuclear reactor malfunctions, large-scale power failures, etc.). The NYSDOT regions have snow and ice kickoff meetings in November every year, led by the regional engineers. The meeting includes a discussion of operational safety for the changeover of equipment from summer work to winter work. Issues pertaining to snow and ice maintenance and operations are also discussed. At the system level, there is at least one statewide drill per year and regions can do individual drills – those are coordinated through the regional emergency management offices.*

*Within approximately two weeks after completion of a major event or drill, NYSDOT's ICS staff develop and distribute an after-action survey to collect information about the operations related to the event. ICS staff review and analyze the survey results and organize an after-action review meeting. Following the completion of these items, an After-Action Report is written by ETO Staff. This report outlines the Department's strengths and areas needing improvement, relative to the type of event. The overall goal of an after action review is to develop an improvement plan and to share best practices across the agency.*

*PennDOT uses a structured agenda to conduct its after-action reviews (see Attachment E).*

*After-action reviews can also be done externally, as a form of audit of the agency's response. A couple of years ago, a snow squall created a 100-plus car pileup including chemical spills and fireworks on a major highway from Detroit to Chicago. After it was cleared and the road re-opened, a contractor was hired by Michigan DOT to do an after-action review of all response activities, due to the high costs of the incident.*

*After-action reviews have also taken the form of tabletop-like exercises, in which a major winter storm is envisioned in unison with a significant traffic problem. This type of exercise would not constitute a winter-storm after-action review specifically, but it can be very useful in identifying potential problems that could arise for a DOT during a severe winter storm.*

# CHAPTER 5: CONCLUSIONS AND FUTURE RESEARCH

Given that there are relatively few emergency-response plans for extreme winter weather, the in-depth interview process essential for uncovering best practices in DOT emergency response. These interviews were especially useful for uncovering information that not covered in great depth in the written plans, (1) the organizational structure of the DOT section responsible for the plan, (2) how the plan was being implemented, and (3) the differing approaches of the case study subjects to managing an emergency response to extreme winter storms. The case study approach facilitated the development of a concrete set of recommended best practices for the development of Emergency Response Plans for Extreme Winter Storms.

While there were many common elements across the case studies, there were also a few differing approaches that were revealed in the interviews. For example, when discussing procedures for shifting personnel within the state during an extreme weather event, some of the interviewees felt that it is important to have the shifted personnel report to the supervisor of the new district they are serving. Others found that shifted personnel needed to stick with the mission given at the statewide level and not be distracted by local supervisory directives. Additionally, some agencies are very specific in their written plans about the roles, procedures, and steps to be taken in a winter weather emergency whereas others find specificity in written plans to be a deterrent to effective operation during an emergency, relying instead on training of personnel to help direct the response in the best way.

The involvement of the state's DEM in a winter weather emergency is perceived differently by different state DOTs. Some DOTs whose emergency operations' staff have a DEM background involve the DEM closely in the DOT response. Others have staff with a maintenance and operations background lead their emergency response, so the DEM is regarded as peripheral to an effective response to severe winter weather.

These differences highlight a more general difference between agencies that felt the most effective response comes from a "bottom-up" approach and other agencies that felt that a "top-down" approach was most effective. The "bottom-up" approach, which stresses more localized control and autonomy, was more typical of agencies whose emergency response was led by staff with a maintenance and operations background. The "top-down" approach, with a firmer centralized mission directive for the response, was more typical of agencies led by staff with a background in emergency management.

It became clear in the interviews that attitudes of motorists toward winter storms may vary from state to state. Motorists are free to travel during severe winter weather and are free to choose any route unless a roadway they choose has been closed. Ultimately, there are steps a DOT can take to lower the expectations of the travelling public and prompt rescheduling trips around adverse weather events. Some interviewees believe the motorists in their state to be less tolerant of these types of inconveniences, and that belief affects their approach to response.

The need for resource-sharing between states also varies regionally. The Midwest Plains' states tend to get more widespread winter weather events, so it is likely that a storm severe enough to overwhelm

one state's resources would also be impacting adjacent states. However, in the East, where coastal weather patterns can be dramatically different from inland lake-effects weather patterns, it might be more common for one state to be hit by a severe winter weather event that has little effect on an adjacent state, so RSIC responses that include an activation of the EMAC are more realistic.

In spite of these differences, all of the approaches discussed in the interviews appeared to be successful, and emblematic of best practices. Although the approaches were different, no specific approach seemed to hinder an agency's ability to provide an effective response. The differences in approach seemed to be primarily the result of the background of staff responsible for emergency response to extreme winter storms. Pursuant to those differences, additional research is need to better understand the challenges of staffing an Office of Emergency Management within a DOT. Development and retention of existing staff members for work in emergency management within a DOT will help response efforts like those covered in this project proceed more effectively. It will be important for DOTs to understand what job skills are needed for emergency management officers who will be able to effectively coordinate a response to extreme winter storms. These skills will likely include DOT operations as well as emergency response experience, which will be more typical of staff in state DEMs. Providing a framework for the ideal skill set and/or experience of a DOT emergency management officer will greatly assist DOTs with the development of their OEMs.

# CHAPTER 6: REFERENCES


Alexander, David, 2002. Principles of Emergency Planning and Management / David Alexander. Oxford ; New York: Oxford University Press.

CDOT, 2017a. Colorado Department of Transportation Threat and Hazard Identification and Risk Assessment. Produced by the Office of Emergency Management, Department of Transportation, March 2017.

CDOT, 2017b. Colorado Department of Transportation Emergency Operation Plan. Produced by the Office of Emergency Management, Department of Transportation, October 2017.

CDOT, 2017c. Emergency Management Standard Operating Procedures (Draft). Produced by the Office of Emergency Management, Department of Transportation, August 2017.

DHS, 2008. National Response Framework. Accessed at https://www.fema.gov/media-library-data/1466014682982-9bcf8245ba4c60c120aa915abe74e15d/National_Response_Framework3rd.pdf in August, 2017.

DHS, 2008. National Response Framework. Produced by the United States Department of Homeland Security, January 2008.

DHS, 2016. National Response Framework, Third Edition. Produced by the United States Department of Homeland Security, June 2016.

DHSEM, 2016. Colorado Hazard and Incident Response and Recovery Plan. Produced by the Colorado Division of Homeland Security & Emergency Management, Department of Public Safety, November 2016.

Erskine, Leenders, & Mauffette-Leenders, 1997. Learning with Cases. Richard Ivey School of Business at the University of Western Ontario.

FEMA, 2009. National Planning Scenarios Fact Sheet. Accessed at https://www.fema.gov/txt/media/factsheets/2009/npd_natl_plan_scenario.txt in August, 2017

FEMA, 2010. Developing and Maintaining Emergency Operations Plans: Comprehensive Preparedness Guide (CPG) 101, Version 2.0. Produced by the Federal Emergency Management Agency of the Department of Homeland Security, November 2010.

GEMA/HS, 2016. Winter Weather Incident Annex : Annex S - Georgia Emergency Operations Plan. Produced by the Planning Section of the Georgia Emergency Management and Homeland Security Agency, 9/7/2016.

Litman, T., 2006. “Lessons From Katrina and Rita: What Major Disasters Can Teach Transportation Planners.” Journal of Transportation Engineering 132 (1): 11–18.

Melillo, Jerry M., Terese Richmond, and G. W. Yohe, 2014. Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program.

MEMA, 2015. Attachment A: Severe Winter Weather Pattern Impacts - Supplemental Information. Produced by the Massachusetts Emergency Management Agency, March 27, 2015.

Mendonca, David, Giampiero EG Beroggi, and William A. Wallace, 2001. "Decision Support for Improvisation during Emergency Response Operations." International Journal of Emergency Management 1 (1): 30–38.

MnDOT, 2017. MnDOT Department-Wide Snow and Ice Plan, Season: 2017 – 2018. Produced by the Minnesota Department of Transportation, June 2017.

MnDPS/HSEM, 2013. State of Minnesota Emergency Operations Plan (Official). Produced by the Minnesota Department of Public Safety - Division of Homeland Security and Emergency Management. Revised September 1, 2013.

MSP/EMHSD, 2016. Michigan Emergency Management Plan. MSP/EMHSD Pub. 101 of the Emergency Management and Homeland Security Division of the Michigan Department of State Police, July 2016.

NJDOT, 2017. Operations Winter Readiness Levels. Produced by the New Jersey Department of Transportation. Undated.

NYSDHSES, 2014. 2014 New York State Hazard Mitigation Plan. Produced by the New York State Division of Homeland Security and Emergency Services, January 2014.

NYSDOT, 2016. Emergency Transportation Operations Playbook, Produced by the New York State Department of Transportation. Revised October 2016.

PennDOT, 2014. All-Hazards Incident Management Manual. Publication No. 911 (12-14) by the Pennsylvania Department of Transportation, December 2014.

PennDOT, 2015. Chapter 9: Emergency Operations. From the Bureau of Maintenance and Operations Maintenance Manual, publication 23 of the Pennsylvania Department of Transportation, Updated 4/15.

Perry, Ronald W., and Michael K. Lindell, 2003. "Preparedness for: Guidelines for the Emergency Planning Process. Disasters 27 (4): 336–50. doi:10.1111/j.0361-3666.2003.00237.x.

SDDOT, 2016. South Dakota Department of Transportation: Winter Highway Maintenance Plan, 2016-2017. Prepared by Greg Fuller, Director of Operations and Jason Humphrey, Construction and Maintenance Engineer, South Dakota Department of Transportation, October 2016.

Squires, Michael F., and Jay H. Lawrimore, 2006. Development of an Operational Northeast Snowfall Impact Scale. Presented at the 22nd International Conference on Interactive Information Processing Systems for Meteorology, Oceanography, and Hydrology, January 2006.

Squires, Michael F., Jay H. Lawrimore, Richard R. Heim Jr., David A. Robinson, Mathieu R. Gerbush, and Thomas W. Estilow, 2014. The Regional Snowfall Index. Bulletin of the American Meteorological Society, December 2014.

Tetra Tech, 2014. State of New Jersey 2014 Hazard Mitigation Plan. Prepared by tetra Tech, Inc. of Morris Plains, NJ for the State of New Jersey Office of Emergency Management.

TxDOT, 2017. Texas Snow and Ice Control Plan. Produced by the Maintenance Division-Winter Storm Committee of the Texas Department of Transportation. Undated.

VDPS, 2013. Vermont's Implementation Plan for the National Incident Management System. Vermont Department of Public Safety, Division of Emergency Management and Homeland Security. December 2013.

VDPS, 2015. State of Vermont Emergency Operations Plan: Base Plan. Vermont Department of Public Safety, Division of Emergency Management and Homeland Security. September 2015.

VTRANS, 2015. Emergency Transportation Operations Plan. Produced by the Maintenance and Operations Bureau of the Vermont Agency of Transportation, May 21, 2015, Rev 1.0 September 21, 2015.

**ATTACHMENT A**

# COLORADO DOT WINTER OPERATIONS CONFERENCE CALL SOP

**Winter Operations Conference Call**

## I. Authorities

A. Article IV, Constitution of the State of Colorado, entitled the Executive Department

B. Title 43, Article 1, Part 1 et seq., C.R.S., entitled Transportation

C. 2016 – 17 CDOT Performance Plan, page 25

## II. Purpose

The purpose of this Standard Operating Procedure (SOP) is to outline the procedures for the conduct of a Winter Operations Conference Call due to an impending storm system.

## III. Situation

A. Severe winter weather is the most disruptive natural hazard that impacts the statewide transportation network. Severe winter weather hazards include snowstorms, blizzards, extreme cold, and ice and sleet storms. As a western state, Colorado is vulnerable to all of these winter hazards. Most of the severe winter weather events that occur in Colorado have their origin as Canadian and Arctic cold fronts that move across the State from the west or northwest, although some of the most significant winter storms have their origins from the southwest, in combination with Arctic air masses. Colorado averages moderate to heavy snowfall and extreme cold, averaging 87 days per year below freezing.

B. Severe winter weather can disrupt the network for a day or two, or for weeks at a time. The earlier the weather system is identified, it's projected path (impact area), and potential severity are identified, the earlier the decisions can be made regarding the scheduling and deployment of CDOT personnel along with the selection of the appropriate product(s) to be used. It must be noted, that due to the different geographical conditions across the State, weather impacts will vary. For example, some parts of the State can receive 1' – 2' of snow with no discernable degradation of highway operations, while a different location may receive 4" – 6" of snow and traffic may be at a standstill.

C. Weather Advisories

The National Weather Service (NWS) serves as the primary official source of weather information. They are responsible for issuing appropriate weather outlooks, watches, and warnings. Below are the basic terms that should be considered during the planning process for winter weather:

1. Outlooks indicate a hazardous weather or hydrologic event may develop. Outlooks are issued up to 7 days prior to the system's arrival in the area.
2. Watches indicate the risk of a hazardous weather or hydrologic event has increased

significantly, but its timing, occurrence, and/or location is uncertain. Usually issued up to 48 hours before arrival.

3. Warnings are issued when a hazardous weather or hydrologic event is occurring, is imminent, or has a high probability of occurring. It is used for conditions posing a threat to life or property.
4. Advisories highlight special weather conditions that are less serious than a warning. They are for events that may cause significant inconvenience, and if caution is not exercised, it could lead to situations that may threaten life and/or property.

## IV. Roles and Responsibilities

A. Winter Operations Manager, Division of Highway Maintenance

1. Monitors severe winter weather system that could adversely impact the State, make recommendations to the Director of Highway Maintenance regarding future operations, and facilitate winter operations conference calls.
2. Will make a preliminary determination as to what Incident Level the storm system will be classified as. If level 4 or 5 is determined, will directly communicate with impacted maintenance sections on weather conditions and operations. No consequence management conference call needed. NWS will continue to develop weather updates. If a level 3 or higher incident level is determined, the more formal process will take place.

B. Maintenance Sections

Monitor weather conditions within their areas of responsibility, track status of personnel and equipment, conduct avalanche mitigation operations (on an as needed basis), and maintain stockpiles of appropriate product.

C. National Weather Service (NWS)

Provides weather forecasts, public warnings, and other weather - related products to organizations and the public for the purposes of protection, safety, and general information.

D. Colorado Avalanche Information Center (CAIC)

Provides accurate information about the snowpack stability throughout Colorado for motorists and backcountry recreationists in order to reduce the number of avalanche deaths in Colorado. Colorado does not have a very stable snow pack compared to many other states, and is often considered to be one of the most dangerous mountain areas in the US.

E. ITERIS

Provides statewide pavement weather forecasting and maintenance decision support services.

F. Colorado Transportation Management Center

Through the use of a closed circuit television system, monitors Interstate and State highway road conditions across the State. Controls fixed variable message signs along the transportation network and displays appropriate information to the traveling public. Can also deploy Courtesy Patrols when the need arises.

G. Office Communications
Issues applicable information to the news media and the general population on the Department's activities and recommended actions to be taken during hazardous conditions. This can be accomplished through the headquarters staff or through Regional staff.

H. Office of Emergency Management
If necessary, provides the interface to the State Emergency Operations Center / Office of Emergency Management – Colorado Department of Public Safety.

## V. Concept of Operations

A. The NWS and the Winter Operations Manager will monitor weather systems that could directly or indirectly impact the State. When appropriate, the NWS will issue Outlooks, Watches, and Warnings for parts or all of Colorado. The issuance of these will require an increased monitoring of the storm system and the identification of potential impacts.

B. The Winter Operations Manager will decide if a Conference Call is necessary. If so, The Manager will coordinate with the NWS – Boulder and CAIC to acquire a PowerPoint™ presentation on impending conditions prior to the scheduled conference call. Once this presentation is received, it will be distributed to Cdot_oem_ops@state.co.us .

C. The Winter Operations Manager will schedule the Conference Call (traditionally at 12:30pm) with the appropriate sections, using a calendar invite. Attendees will include:

1. Brian Lazar brian.lazar@state.co.us
2. CAIC – Colorado Avalanche Center caic@state.co.us
3. CMTC Branch Manager – Bill Miederhoff William.miederhoff@state.co.us
4. CMTC Supervisor – Rod Mead rod.mead@state.co.us
5. Director Division of Highway Maintenance – Kyle Lester kyle.lester@state.co.us
6. Director TSM&O – Ryan Rice ryan.rice@state.co.us
7. Ethan Greene ethan.greene@state.co.us
8. I-25 Corridor Manager – Kevin Devine kevin.devine@state.co.us
9. I-70 Corridor Manager – Patrick Chavez Patrick.chavez@state.co.us
10. Iteris wxservices@iteris.com
11. NWS Boulder cr.bou-ops@noaa.gov
12. NWS Grand Junction cr.gjt@noaa.gov
13. NWS Pueblo cr.pueblo@noaa.gov

14. OEM Director – Chad Ray chad.ray@state.co.us
15. OEM Communications – Jack Cobb jack.cobb@state.co.us
16. OEM Operations – Jori Ernst jori.ernst@state.co.us
17. OEM Planning Section Chief – Kerry Kimble Kerry.kimble@state.co.us
18. Pathfinder Project Manager – Lisa Streisfeld lisa.streisfeld@state.co.us
19. Winter Operations Manager – David Johnson c.david.johnson@state.co.us

D. CDOT - OEM Conference Bridge will be used: 1-877-820-7831 (Participation Code: 118127#, Moderator Code: 9147541)

E. The Conference Call will be facilitated by the Winter Operations Manager using the following agenda (the form at the end of the SOP can also be used):

1. National Weather Service – Statewide briefing of current forecast with identified weather matrix.
   a. Storm anticipated beginning and ending times.
   b. Snow accumulations, rate per hour, winds, gusts and visibility.
2. CAIC – Colorado Avalanche Information Center
   a. Brief on potential avalanche issues within the impacted areas of the storm
   b. CAIC will be included on conference calls 12 hours pre storm.
3. Iteris – Statewide briefings focused on current conditions and roadway weather.
   a. Utilize roadway sensors for actual and current impacts.
   b. Utilize MDSS for current and forecasted roadway impacts.
4. Each Maintenance Section should be prepared to update and present the following information for situational awareness during the conference call:
   a. Current operations being conducted
   b. Current status of equipment, personnel or product (including needs, shortages or concerns).
   c. Any areas of concern (geographical areas, infrastructure or impacts).
   d. Any communication issues (public information issues or 800 Mhz communication issues).
   e. Need for any additional resources.
   f. Can you sustain continued operations for another 24 hours?
   g. Who is the event coordinator?
5. CTMC
   a. Staffing status.
   b. Need for the snow desk.
   c. Need for the Courtesy Patrol.
   d. Any concerns or issues?
6. The group will discuss what Incident Level the storm should be (and the resulting actions to be taken). For general consideration:
   a. Level 3: 3 - 4 maintenance sections will be required to deploy road clearing staff for extended periods of operations or the scheduling of additional shifts

throughout the entirety of the event. A Departmental Incident Management Team is activated.

b. Level 2: 5 - 6 maintenance sections will be required to deploy road clearing staff for extended periods of operations or the scheduling of additional shifts throughout the entirety of the event. Resources from non – impacted maintenance sections are being re – directed (internal mutual aid).
c. Level 1: A statewide event that will impact 7 or 8 maintenance sections will be required to deploy road clearing staff for extended periods of operations or the scheduling of additional shifts throughout the entirety of the event. A re – distribution of internal resources is conducted (internal mutual aid). Consideration of coordination with neighboring States for the clearing of highways beyond the political border (this would apply for CDOT plowing another State's portion of the highway, and their DOT organization may plow Colorado's portion of the highway.) (External mutual aid.) The Departmental Operations Center is activated.
d. A decision tree is located in Appendix 1.

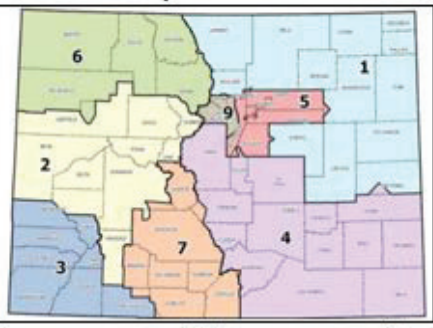
7. Public Information
   a. What is the overall message that we want to put out?
   b. Who will be responsible for that message, the Regions or HQ?
8. The Winter Operations Manager will schedule a follow – up Conference Call if necessary.

## VI. Documentation

At the end of the Conference Call, the conversation / decisions made need to be documented. One option for this documentation is to utilize the form below.

## Winter Operations Conference Call

**Call in #1-877-820-7831**
**Passcode 118127#**
**Moderator 9147541#**




Date: _____

Time: _____

Prepared by: _____

Distribution list: cr.bou-ops@noaa.gov, cr.pub@noaa.gov, cr.gjt-mets@noaa.gov, caic@state.co.us, cdot_oem_Ops@state.co.us,

**THE PURPOSE of the call is to obtain an update on the incoming storm, obtain the status of CDOT resources, and determine appropriate Public Information messaging.**

**Reminder to everyone to mute your phones until it is your turn to speak.**

**Agenda**

| | |
|---|---|
| NWS Boulder | Comments: |
| NWS Grand Junction | Comments: |
| NWS Pueblo | Comments: |
| CAIC | Comments: |
| ITERIS | Comments: |

Weather agencies can drop off the call at this point.

| | Personnel | Equipment | Liq Prod | Solid Prod | Concerns |
|---|---|---|---|---|---|
| Maint Sect 1 | % | % | % | % | |
| Maint Sect 2 | % | % | % | % | |
| Maint Sect 3 | % | % | % | % | |
| Maint Sect 4 | % | % | % | % | |
| Maint Sect 5 | % | % | % | % | |
| Maint Sect 6 | % | % | % | % | |
| Maint Sect 7 | % | % | % | % | |
| Maint Sect 9 | % | % | % | % | |

| | |
|---|---|
| CTMC (TOC, JOA, HGL, Pueblo, Greeley) | Comments: |

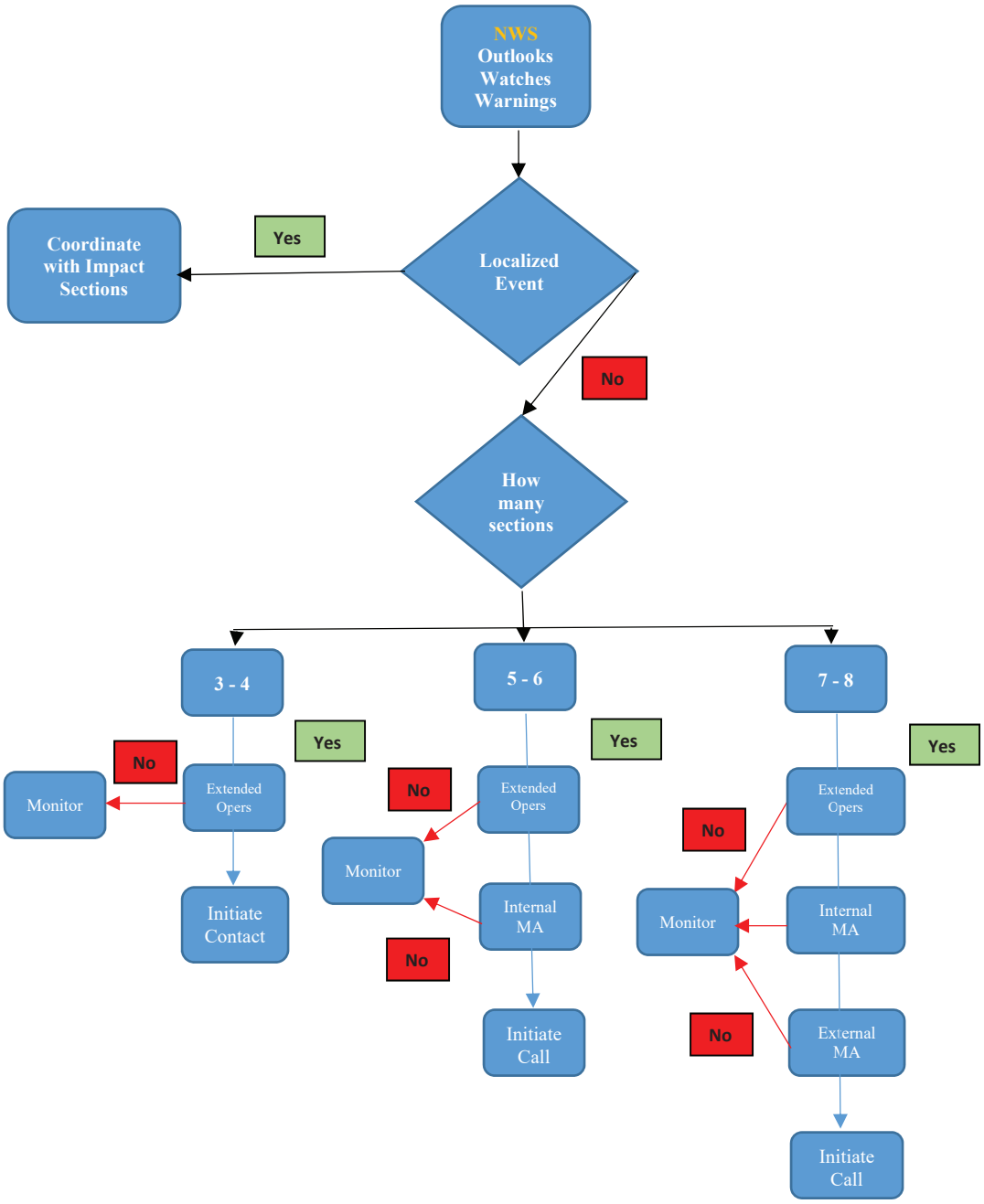
Operations can drop off the call at this point.

| | |
|---|---|
| Public Information | Comments:<br>Strategies, regional messages, |

**Any need to change the Incident Level?**

**Next conference call?**

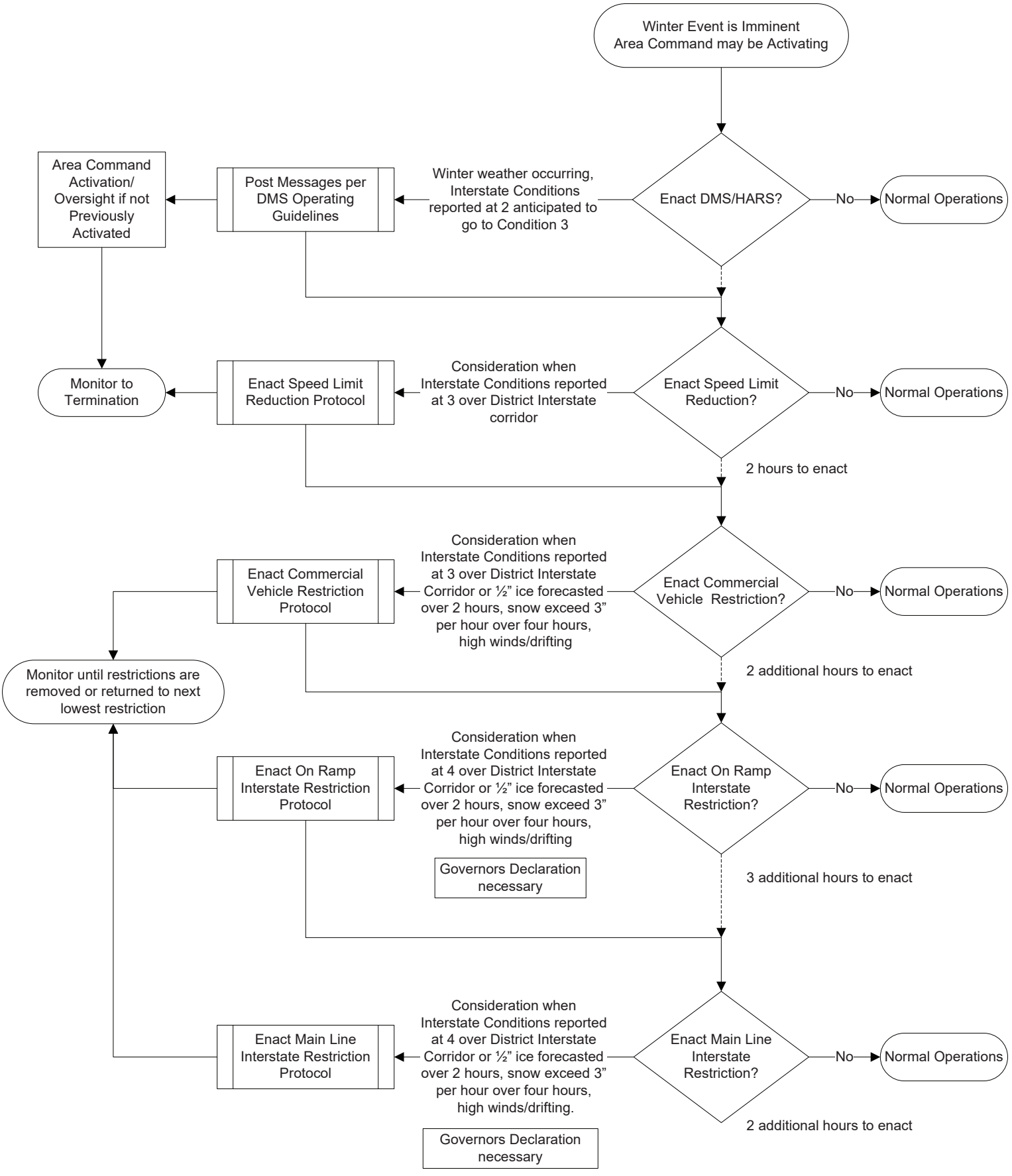
Appendix 1
Decision Tree for Incident Levels



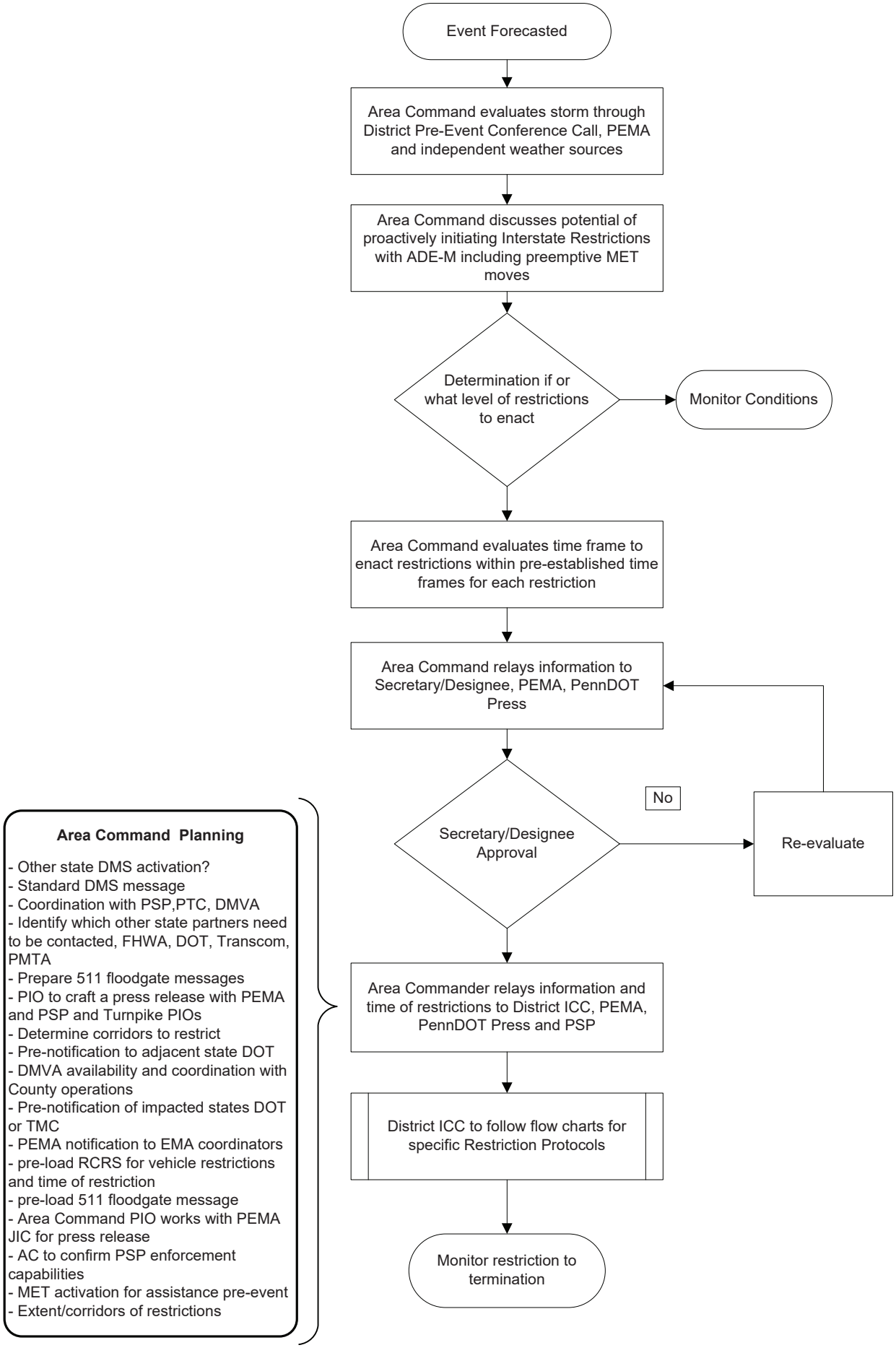
**ATTACHMENT B**

# PENNDOT DECISION TREES FOR RESTRICTION PROTOCOLS

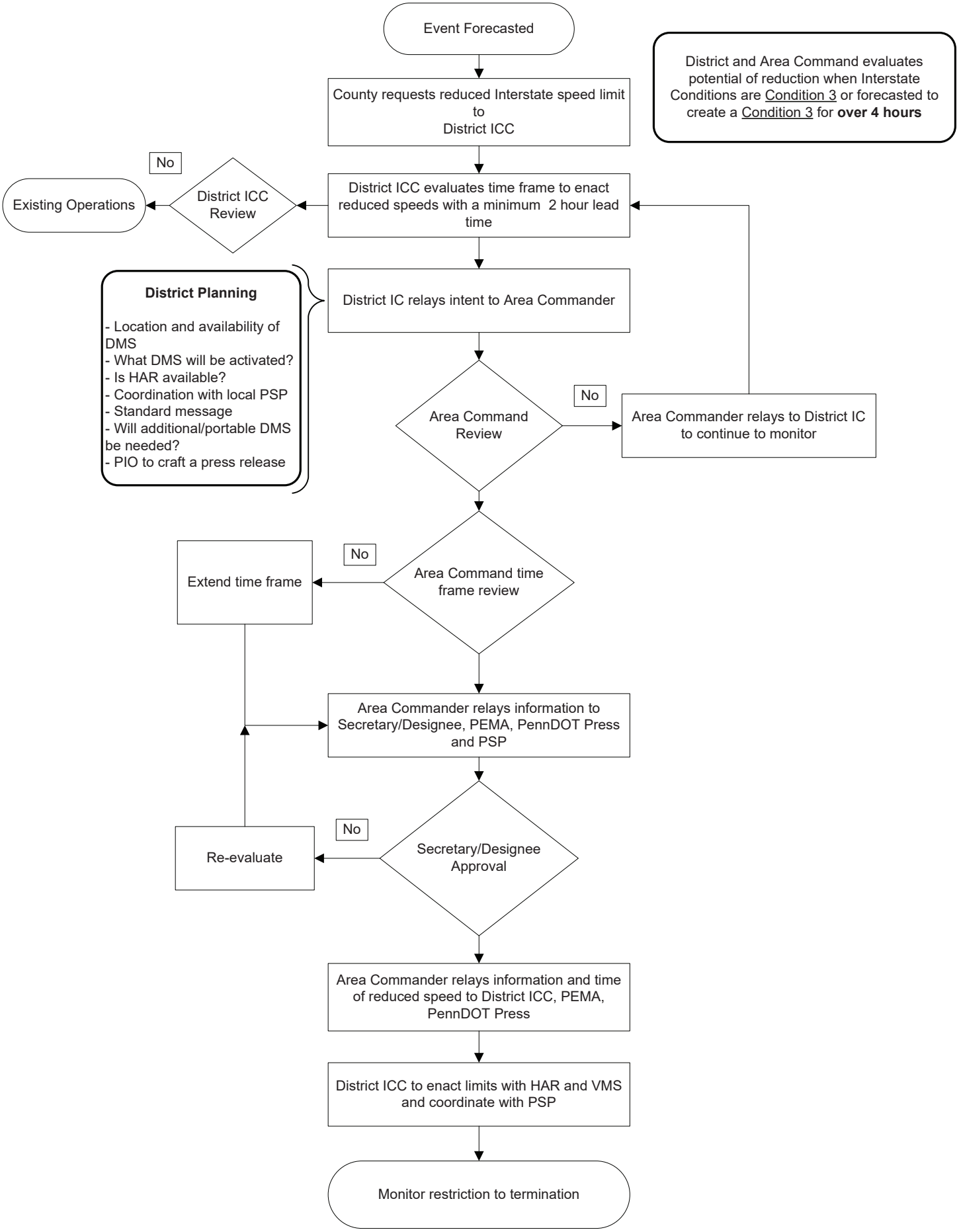
# Decision Tree for Weather Related Restrictions on Interstate/Limited Access Highways



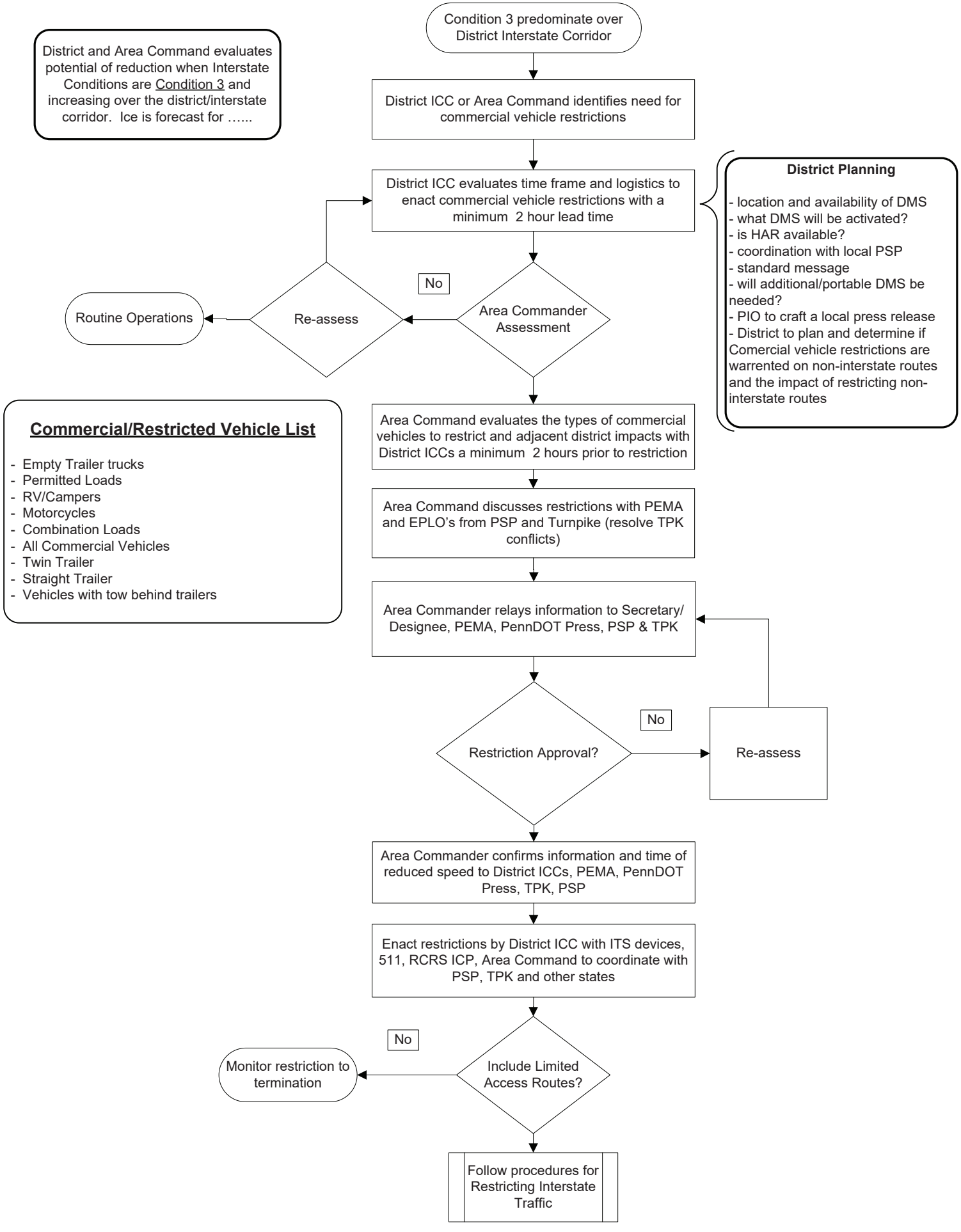
# PennDOT Winter Weather Pre-Emptive Restrictions



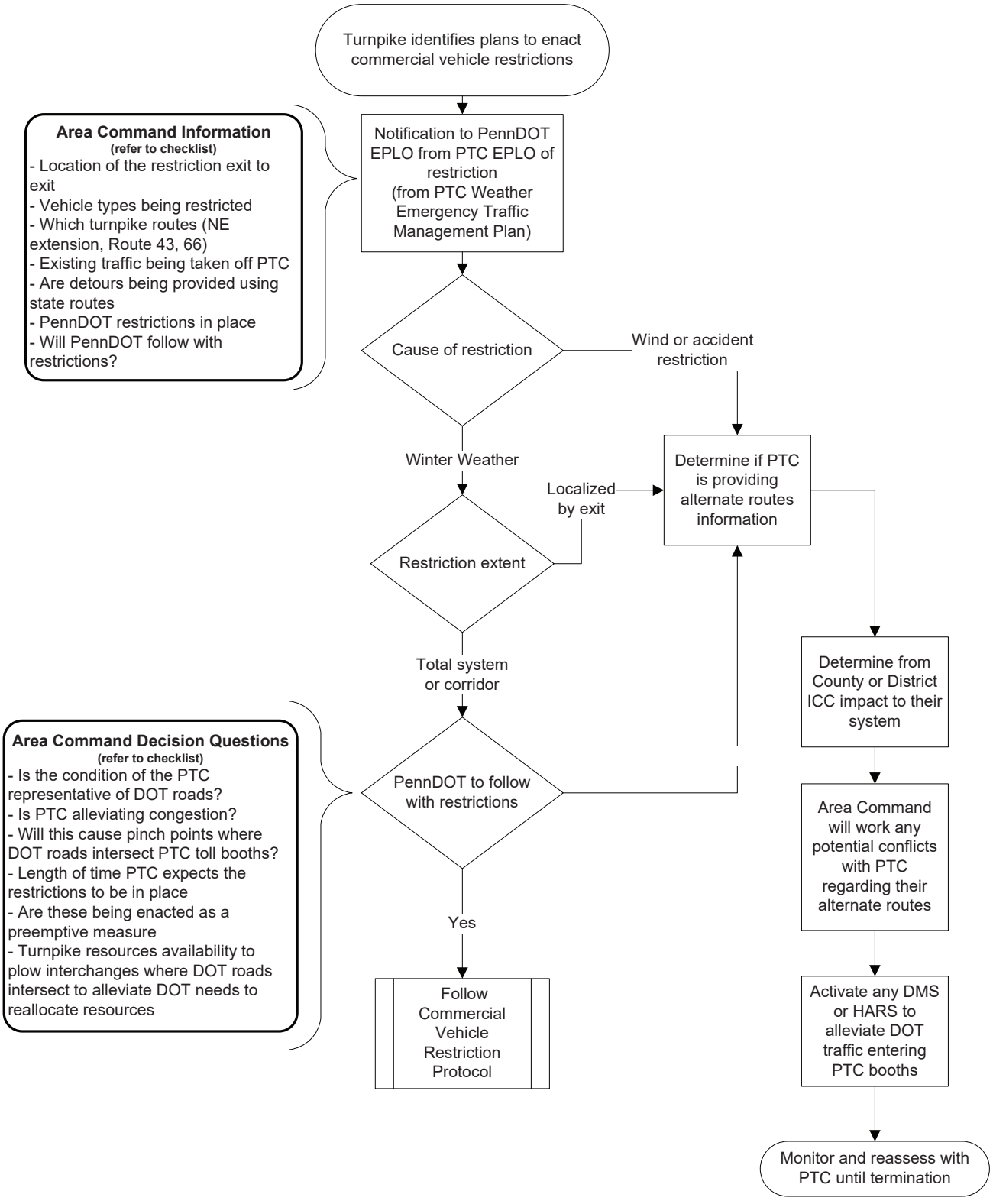
# PennDOT Interstate/Limited Access Reduced Speed Limit Process (Condition 3)



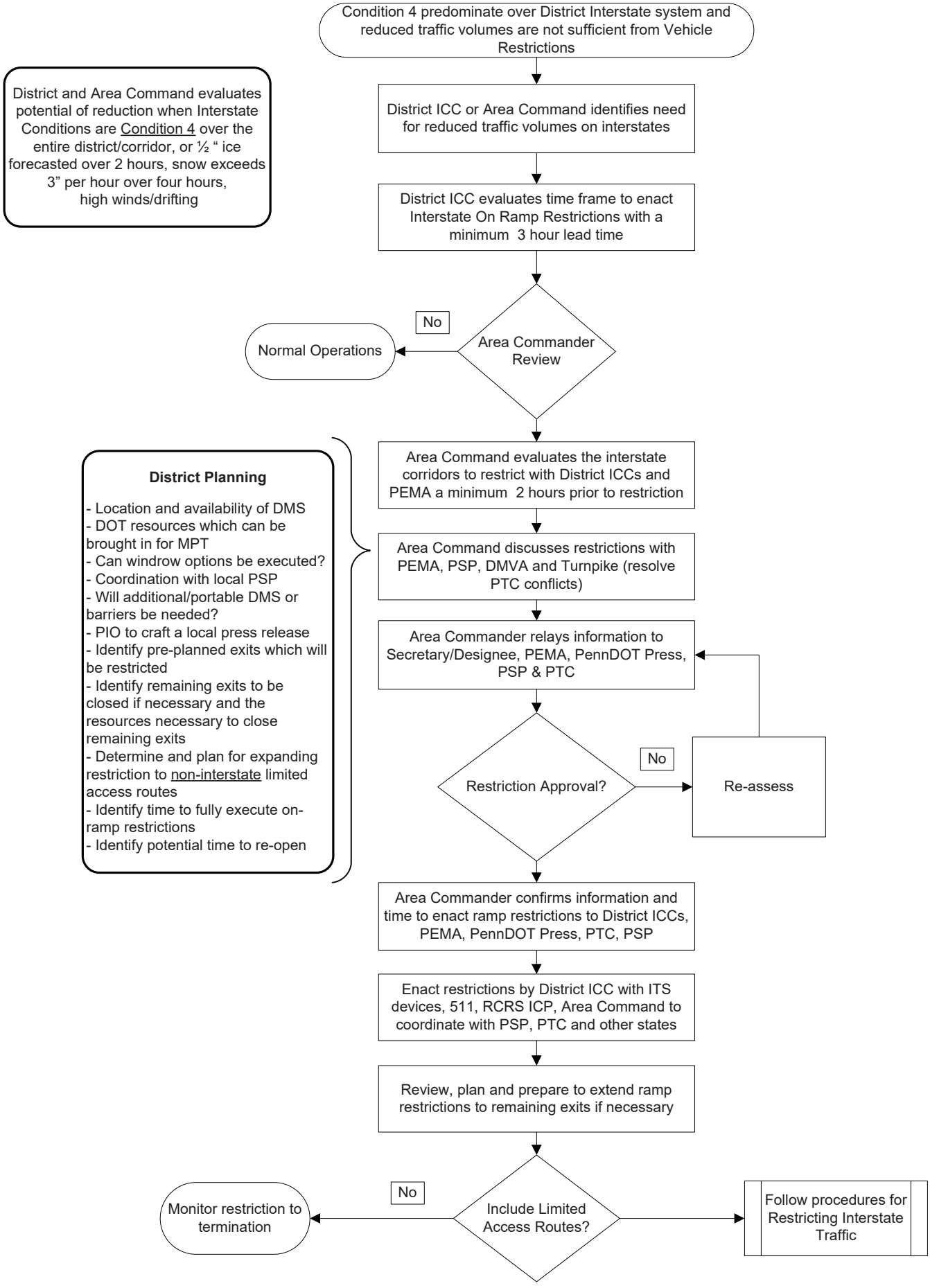
# PennDOT Interstate Commercial Vehicle Restriction Protocol (Condition 3)



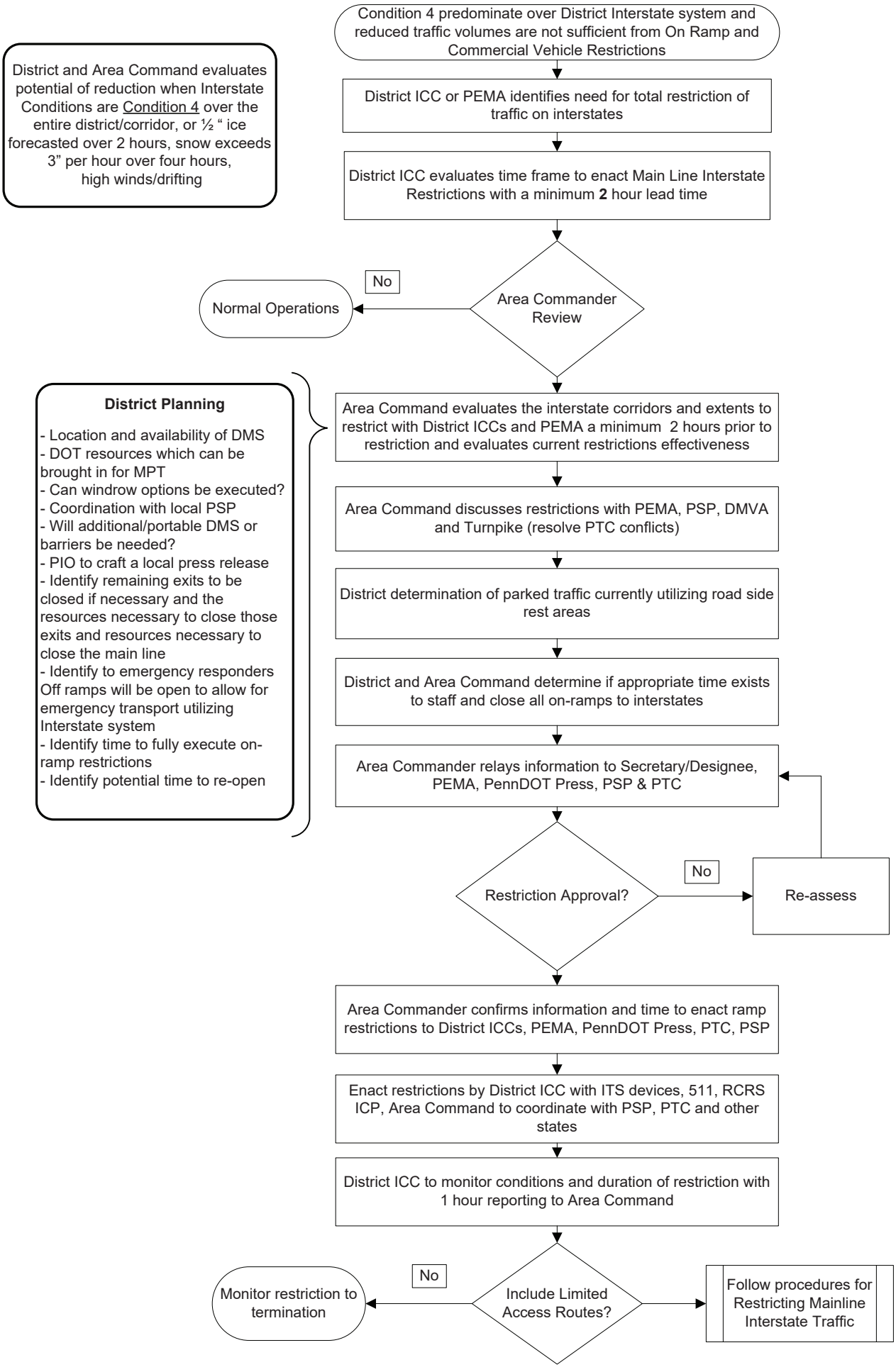
# PennDOT response to Turnpike Commercial Vehicle Restriction Protocol



# PennDOT Interstate On Ramp Restriction Protocol (Condition 4)



# PennDOT Interstate Mainline Restriction Protocol (Condition 4)



**ATTACHMENT C**

# VTRANS MEMORANDUM OF UNDERSTANDING REGARDING EMERGENCY CLOSURE OF HIGHWAYS

**MEMORANDUM OF UNDERSTANDING**
**BETWEEN**
**AGENCY OF TRANSPORTATION**
**AND**
**DEPARTMENT OF PUBLIC SAFETY**
**REGARDING**
**EMERGENCY CLOSURE OF STATE HIGHWAYS**

**THIS MEMORANDUM OF UNDERSTANDING** ("MOU") is made this ____ day of _____, 2012, by and between the Vermont Agency of Transportation ("VTrans") and the Vermont Department of Public Safety ("DPS").

**WHEREAS,** occasionally it becomes necessary to temporarily close state highways due to emergency situations created by snow-covered or icy pavements, floods, winds, or other natural disasters, as well as crashes, fires, hazardous material incidents, or other events that present a definite hazard to the traveler; and

**WHEREAS,** 23 V.S.A. § 1006a(a) authorizes the State Traffic Committee to close any part or all of any state highway to public travel to protect the health, safety or welfare of the public and, further, directs VTrans to properly mark and maintain a detour around the closed section; and

**WHEREAS,** 23 V.S.A. § 1006a(c) (Highways; emergency closure) further authorizes the State Traffic Committee, acting under the Administrative Procedures Act, 3 V.S.A. Chapter 25, to make and promulgate such rules as are necessary to administer Section 1006a and to delegate authority under Section 1006a to VTrans; and

**WHEREAS,** on or about October 1, 1975, the State Traffic Committee promulgated the following rule:

RULES RELATING TO THE CLOSURE
OF STATE HIGHWAYS

1. When the Traffic Committee finds that the health, safety, or welfare of the public requires that certain portions of the state highway system be closed to public travel during periods of winter weather, the committee, at the recommendation of the District Highway Engineer of the Vermont Department of Highways within whose District the highway in question is located may open and close said highways following the same procedures as set forth in 3 VSA § 803.

2. The Traffic Committee hereby delegates the authority to close portions of the state highways for emergency reasons to the District Highway Engineers of the Vermont Department of Highways and the Troop Commanders of the Vermont State Police. In the event that a closure occurs, the individual authorizing such closure shall, within 24 hours, make a written report to the Traffic Committee setting forth the events and/or circumstances requiring the closing.

and

**WHEREAS,** VTrans is the successor to the former Vermont Department of Highways, while the former District Highway Engineers have been succeeded by the District Transportation Administrators; and

**WHEREAS,** 19 V.S.A. § 10(3) (Duties of the Agency of Transportation) authorizes VTrans to direct traffic on all state highways which are under construction and maintenance, to close all or any part of a state highway which is under construction or repair; to properly mark sections of highways which are closed to traffic, and to maintain detours around closed sections; and

**WHEREAS,** 20 V.S.A. § 2673(c) (Powers and duties during hazardous chemical or substance incident, fires; threat of fires or explosions) gives the ranking member of a fire department authority to direct, control and supervise traffic at the scene of a fire or other emergency to which a fire department has responded; and

**WHEREAS,** 23 V.S.A. § 1021(a) (Obedience to traffic-control devices) and 23 V.S.A. § 1602 (Traffic Control) recognize the authority of law enforcement officers to control and direct motor vehicle traffic; and

**WHEREAS,** VTrans and DPS wish to describe their working relationship and shared responsibility to provide safe movement of traffic and necessary notification to the traveling public when the need arises to temporarily close state highways due to emergency situations;

**NOW, THEREFORE,** VTrans and DPS agree as follows:

**1. Internal Delegations Within DPS and VTrans.** Within DPS, the Director of the State Police has designated the Troop Commander and, in his or her absence, the Zone Duty Officer as the responsible field supervisors for the State Police. Within VTrans, the Director of Operations has designated the District Transportation Administrator and, in his or her absence, the District General Maintenance Manager, as the responsible field supervisors for VTrans. These are the only individuals with the legal authority under 23 V.S.A. § 1006a to close a state highway during an emergency.

**2. Cooperation with Other Officials.** The parties recognize that under some circumstances other state or municipal officials may have authority under other state statutes to direct, control and supervise traffic at the scene of an emergency. See, for example, 20 V.S.A. § 2673(c) (authority of ranking member of a fire department to direct, control and supervise traffic at the scene of a fire or other emergency to which a fire department has responded).

**3. Interagency Notification; Consultation.** Any Vermont state highway, including the Interstate System, may be closed by any of the designated officials after notifying the other agency. Whenever possible, field representatives of both agencies will discuss the reasons for closing and explore all available options before the decision to close is finalized. In the event that a closure occurs, the individual authorizing such closure shall notify the VTrans Transportation Operations Center (TOC). The TOC shall keep a log of all closures that are entered into the 511 system, and shall provide a quarterly summary report to the Traffic Committee's Coordinator via e-mail, setting forth the events and/or circumstances requiring the closings. The parties understand that in some instances the highway already may be physically closed because of a

crash, hazard, or other obstruction on the roadway. In such instances, it is important for police or fire units on the scene to notify the appropriate State Police dispatch center as well as the VTrans General Maintenance Manager. The State Police dispatch center will then notify the VTrans Transportation Operations Center (TOC).

**4. Internal Notifications; Consultation.** The State Police officer or the VTrans Operations Division employee at the scene will notify his or her immediate supervisor of the problem and explain the reasons why the state highway should be, or already is, closed.

The State Police supervisor will notify his or her Troop Commander or in his or her absence the Zone Duty Officer of the problem. The VTrans Operations Division supervisor will notify his or her District Transportation Administrator or in his or her absence the District General Maintenance Manager.

These field supervisors will contact each other to discuss possible courses of action. If closing is the accepted solution, then each should instruct his or her appropriate field forces to proceed.

**5. Media Notification.** The local State Police Troop Commander or his or her designee shall be responsible for notifying the media (radio, television, and local newspapers) of the closing and requesting their assistance in informing the general public.

**6. Public Notification.** The VTrans TOC is responsible for entering information about the closure into the VTrans 511 system. The TOC will also utilize other available technology, such as Variable Message Signs (VMS) to alert the public of closures as appropriate.

**7. Signs and Other Traffic Control Devices.** VTrans, through the Operations Division's district maintenance forces, will provide any available signs, barricades, and traffic control devices to properly direct traffic while the state highway is closed. If the closure is expected to be of long duration (2-3 hours), the on-site VSP and VTrans authority will jointly meet to determine the length of anticipated delay and the feasibility of providing alternate routes or detours. Both agencies share the responsibility for the effective control of traffic during this period.

**8. Closure of Town Highways.** The parties recognize that authority to close town highways and city streets rests with the legislative body of the municipality. Accordingly, the legislative body of the municipality or its representative must assume control and make this determination.

**9. Access to Closed Highway by Local Residents.** Even though a state highway has been closed to through traffic, local residents living within the closed area must be allowed access, except when the hazard is so imminent as to preclude even access by local residents.

**10. Post-closure Procedures.** The parties understand that both agencies should immediately restore the state highway to service and remove all temporary traffic control devices, once crashed vehicles, hazard or other obstruction of the highway has been eliminated. VTrans TOC will update the 511 system immediately after service has been restored on the state highway.

**11. MOU Term; Cancellation.** This MOU will take effect upon execution by both parties and will remain in effect indefinitely. This MOU may be canceled by either party by giving written notice to the other party at least six (6) months in advance.

**AGENCY OF TRANSPORTATION**

Brian R. Searles
Secretary of Transportation

Date: Feb. 17, 2012

Recommended for approval:

Scott A. Rogers
Director of Operations

Date: Jan. 23rd, 2012

**DEPARTMENT OF PUBLIC SAFETY**

Keith W. Flynn
Commissioner of Public Safety

Date: 2/23, 2012

Recommended for approval:

Thomas L'Esperance 2-22-12
Col. Thomas L'Esperance
Director of Vermont State Police

Date: _____, 2012

APPROVED AS TO FORM:

DATE: 2/16/2012
ASSISTANT ATTORNEY GENERAL

g:\wptext\DPS – MOU on Closing State Highways 01 28 2012.doc

**ATTACHMENT D**

# 2014 NEW YORK STATE HAZARD MITIGATION PLAN SEVERE WINTER STORM THREAT ASSESSMENT

# Section 3.15: SEVERE WINTER STORM

| 2014 SHMP Updates |
|---|
| • Annual average snowfall map has been added.<br>• Historical and Recent Events and Losses table added.<br>• Presidential Declared Disaster table and map has been added.<br>• Vulnerability and loss data from local plans have been addressed. |

## 3.15.1 Winter Storm Profile

New York State is located at relatively high latitude and exposed to large quantities of moisture from the Great Lakes and the Atlantic Ocean; therefore, it is highly susceptible to severe winter storms. Occasionally these storms are large enough to encompass almost the entire state.

| Hazard | Terms and Definitions |
|---|---|
| **Winter Storm** | • *Weather Advisory* – this alert may be issued for a variety of severe conditions. Weather advisories may be announced for snow, blowing or drifting snow, freezing drizzle, freezing rain, or a combination of weather events.<br>• *Winter Storm Watch* – severe winter weather conditions may affect your area (freezing rain, sleet or heavy snow may occur separately or in combination).<br>• *Winter Storm Warning* – severe winter weather conditions are imminent.<br>• *Freezing Rain or Freezing Drizzle* – rain or drizzle is likely to freeze upon impact, resulting in a coating of ice glaze on roads and all other exposed objects.<br>• *Sleet* – small particles of ice usually mixed with rain. If enough sleet accumulates on the ground, it makes travel hazardous.<br>• *Blizzard Warning* – sustained wind speeds of at least 35 mph are accompanied by considerable falling or blowing snow. This alert is the most perilous winter storm with visibility dangerously restricted.<br>• *Frost/Freeze Warning* – below freezing temperatures are expected and may cause significant damage to plants, crops and fruit trees.<br>• *Wind Chill* – a strong wind combined with a temperature slightly below freezing can have the same chilling effect as a temperature nearly 50 degrees lower in a calm atmosphere. The combined cooling power of the wind and temperature on exposed flesh is called the wind-chill factor. |

## Characteristics

Severe Winter Storm is defined as an event that occurs during the winter season that includes one or more of the following conditions: snow, ice, high winds, blizzard conditions, and other wintry conditions; causing physical damage or loss to improved property (NWS, 2013). It can range from a moderate snow over a few hours to a blizzard with blinding wind driven snow that can last for multiple days. During late October through mid-April, temperatures can range between 0 degree Fahrenheit and 32 degree Fahrenheit with February having the greatest average snowfall. Cold moisture combined with high wind and large accumulations of snow cause "Lake Effect" storms. Lake Effect storms leave huge quantities of snow with a few days in its wake. They primarily affect the western and central region of New York, but have been known to affect the eastern portion of the State, if the storm becomes large enough.

Extreme cold and heavy snowfall can immobilize the entire state causing road closures, power outages, disruption in communication services, and no heat for several days, under the most severe circumstances. Severe storms can require persons to abandon their homes and seek shelter.


*February 8, 2013, **Winter Storm Nemo** caused New York, Massachusetts, Connecticut, New Hampshire and Rhode Island to declare states of emergency after dumping a massive three feet of snow across the North East Coast.*

The severity or magnitude of a severe winter storm depends on several factors including a region's climatological susceptibility to snowstorms, snowfall amounts and rates, wind speeds, temperatures, visibility, storm duration, topography, time, day of the week, and season.

The extent of a severe winter storm can be classified by meteorological measurements, such as those above, and by evaluating its societal impacts. The Northeast Snowfall Impact Scale (NESIS) categorizes snowstorms, including Nor'easter events, in this manner. Unlike the Fujita Scale, which measures the impact of tornados and Saffir-Simpson Scale, which classify hurricanes, there is no widely used scale to categorize snowstorms. NESIS was developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service (NWS) to characterize and rank high impacts of northeastern snowstorms. These storms have large areas of 10 inch snowfall accumulations and greater. NESIS has five ranking categories: Notable (1), Significant (2), Major (3), Crippling (4), and Extreme

(5). **Table 3.15a** identifies and describes each ranking. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus, NESIS gives an indication of a storm's societal impacts. This scale was developed because of the impact northeast snowstorms can have on the rest of the country in terms of transportation and economic impact (Kocin and Uccellini, 2011).

### Table 3.15a: NESIS Ranking Categories

| Category | Description | NESIS Range | Definition |
|---|---|---|---|
| **1** | Notable | 1.0 – 2.49 | These storms are notable for their large areas of 4-inch accumulations and small areas of 10-inch snowfall. |
| **2** | Significant | 2.5 – 3.99 | Includes storms that produce significant areas of greater than 10-inch snows while some include small areas of 20-inch snowfalls. A few cases may even include relatively small areas of very heavy snowfall accumulations (greater than 30 inches). |
| **3** | Major | 4.0 – 5.99 | This category encompasses the typical major Northeast snowstorm, with large areas of 10-inch snows (generally between 50 and 150 × 103 $mi^{-2}$— roughly one to three times the size of New York State with significant areas of 20-inch accumulations |
| **4** | Crippling | 6.0 – 9.99 | These storms consist of some of the most widespread, heavy snows of the sample and can be best described as crippling to the northeast U.S, with the impact to transportation and the economy felt throughout the United States. These storms encompass huge areas of 10-inch snowfalls, and each case is marked by large areas of 20-inch and greater snowfall accumulations. |
| **5** | Extreme | 10+ | The storms represent those with the most extreme snowfall distributions, blanketing large areas and populations with snowfalls greater than 10, 20, and 30 inches. These are the only storms in which the 10-inch accumulations exceed 200 × 103 mi2 and affect more than 60 million people. |

*Source: Kocin and Uccellini, 2004*

NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. These numbers are calculated into a raw data number ranking from "1" for an insignificant fall to over "10" for a massive

snowstorm. Based on these raw numbers, the storm is placed into its decided category. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers (Enloe, 2011).

While it is almost certain that a number of significant winter storms will occur during the fall and winter seasons, it is difficult to predict how many storms will occur during that time frame. For example, during the calendar year 1997, three (3) significant winter storms occurred. In contrast, during the calendar year 2000, the State encountered sixteen (16) storms.

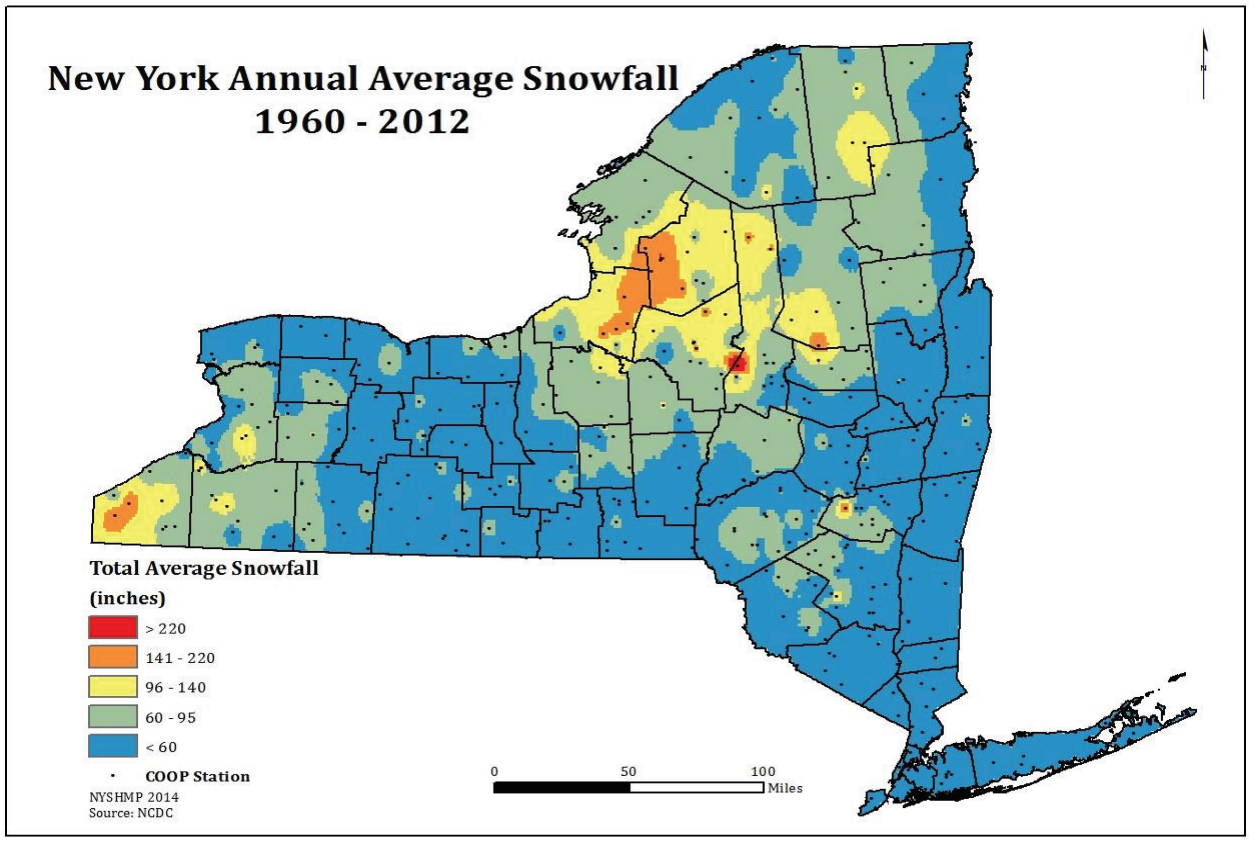
## Location

On average, New York receives more snow fall than other states within the United States. Average annual snowfall is about 65 inches, but it varies greatly in different regions of the State. Although the entire State is subject to severe winter storms, the easternmost and west-central portions of the State are more likely to suffer under severe winter storm occurrences than the southern portion.

Albany, Syracuse, Buffalo and Rochester are typically in the top ten cities in the nation in annual snowfall. Hamilton and Essex are rural low populous counties and home to the six (6) million-acre Adirondack Park, which also receive extensive annual snowfall. Parts of Chautauqua, Herkimer, Jefferson, Oswego, and Lewis Counties receive the heaviest snowfall averaging 96-220 inches annually. The coastal region of the State has the lightest annual snowfall, but is extremely vulnerable to Nor'easters if a hurricane or coastal storm occurs.

**Figure 3.15a** is a map of historical average snowfall totals for the State. The National Weather Service's Cooperative Observer Program (COOP) collects daily meteorological data, including snowfall. Monthly totals for the years of 1960-2012 were used to create the annual average surface from the COOP stations. This figure shows a clear visual of areas that are subject to future occurrences and vulnerable to high levels of snowfall.

**Figure 3.15a: New York Annual Average Snowfall 1960-2012**



**FEMA 9523.1 Snow Assistance Policy**

Entities that meet the applicant eligibility, 44 CFR §206.222, and are performing work that meets the requirements of general work eligibility, 44 CFR §206.223, are eligible for snow assistance.

Eligible work, under Category B, emergency protective measures, as described in the Public Assistance Guide, FEMA 322 (PDF), includes snow removal, snow dumps, de-icing, salting, and sanding of roads and other facilities essential to eliminate or lessen immediate threats to life, public health, and safety. In addition, activities related to the snowstorm such as search and rescue, sheltering, and other emergency protective measures are eligible work. Other categories of work may be eligible under a snowstorm declaration where appropriate.

In a major disaster declaration for a Severe Winter Storm, snow removal costs are not eligible for FEMA assistance if the county does not meet the requirements for snow assistance under paragraph (B) of this policy. A limited level of snow removal incidental to disaster response may be eligible for assistance. Generally, snow removal that is necessary to perform otherwise eligible emergency work is eligible. For example, snow removal necessary to access debris or to repair downed power lines is eligible, while normal clearance of snow from roads is not eligible. (FEMA, 2013)

## Previous Winter Storm Occurrences

New York State Department of Homeland Security and Emergency Services (DHSES) Mitigation staff researched several data sources for historical winter storm records including NYS Office of Emergency Management archives, FEMA statistics, Disaster Declaration data, Spatial Hazard Events and Losses Databases for the United States (SHELDUS), and NOAA's National Climatic Data Center (NCDC) storm event database. According to FEMA, 11 major severe winter storm events occurred from 1976 to 2013 causing Presidential Disaster Declarations. **Table 3.15a** documents severe winter storm Presidential declaration events that occurred from 1976-2013 (excluding emergency declarations).

### Table 3.15b: Severe Winter Storm Presidential Declarations 1976-2013

| Disaster Number | Date Declared | Affected Locations |
|---|---|---|
| **DR-4111** | 4/23/2013 | Suffolk County |
| **DR-1957** | 2/18/2011 | Nassau and Suffolk Counties |
| **DR-1827** | 3/4/2009 | Albany, Columbia, Delaware, Greene, Rensselaer, Saratoga, Schenectady, Schoharie and Washington Counties |
| **DR-1467** | 5/12/2003 | Cayuga, Chenango, Livingston, Madison, Monroe, Oneida, Onondaga, Ontario, Orleans, Oswego, Otsego, Schenectady, Seneca, Wayne, and Yates Counties |
| **DR-1404** | 3/1/2002 | Erie County |
| **DR-1196** | 1/6/1998 | Clinton, Essex, Franklin, Jefferson, Lewis, and Saint Lawrence Counties |
| **DR-1083** | 1/12/1996 | Albany, Bronx, Columbia, Delaware, Dutchess, Greene, Kings, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland County, Suffolk, Sullivan, Ulster, and Westchester Counties |
| **DR-898** | 3/21/1991 | Allegany, Genesee, Jefferson, Lewis, Livingston, Monroe, Ontario, Orleans, Saint Lawrence, Steuben, Wayne, Wyoming, and Yates Counties |
| **DR-801** | 11/10/1987 | Albany, Columbia, Dutchess, Greene, Putnam, Rensselaer, Saratoga, Schenectady, and Washington Counties |
| **DR-527** | 2/5/1977 | Cattaraugus, Chautauqua, Erie, Genesee, Jefferson, Lewis, Niagara, Orleans, and Wyoming Counties |
| **DR-494** | 3/19/1976 | Cattaraugus, Chautauqua, Erie, Genesee, Livingston, Monroe, and Wyoming Counties |

**Figure 3.15b** displays the Presidential declared disaster totals by county for winter events for the period of 1954 through July 2013. Monroe and Genesee Counties have the highest number of winter declarations.

**Figure 3.15c** references NYS winter events by county from 1960-2012. The highest number of Severe Winter Storm occurrences from 1960-2012 were in Western, Central and Northern New York State. On average 290-370 events were reported in the following counties: Chautauqua, Erie, Oswego, Oneida, Lewis, St. Lawrence, Franklin, Clinton and Essex. The lowest number of occurrences was along the coastal region of the State in Suffolk, Nassau, Bronx, Queens, Kings, Richmond, Rockland and Westchester Counties with 60-89 events

**Figure 3.15b: Presidential Disaster Declarations for Winter Events for 1954- 2013**

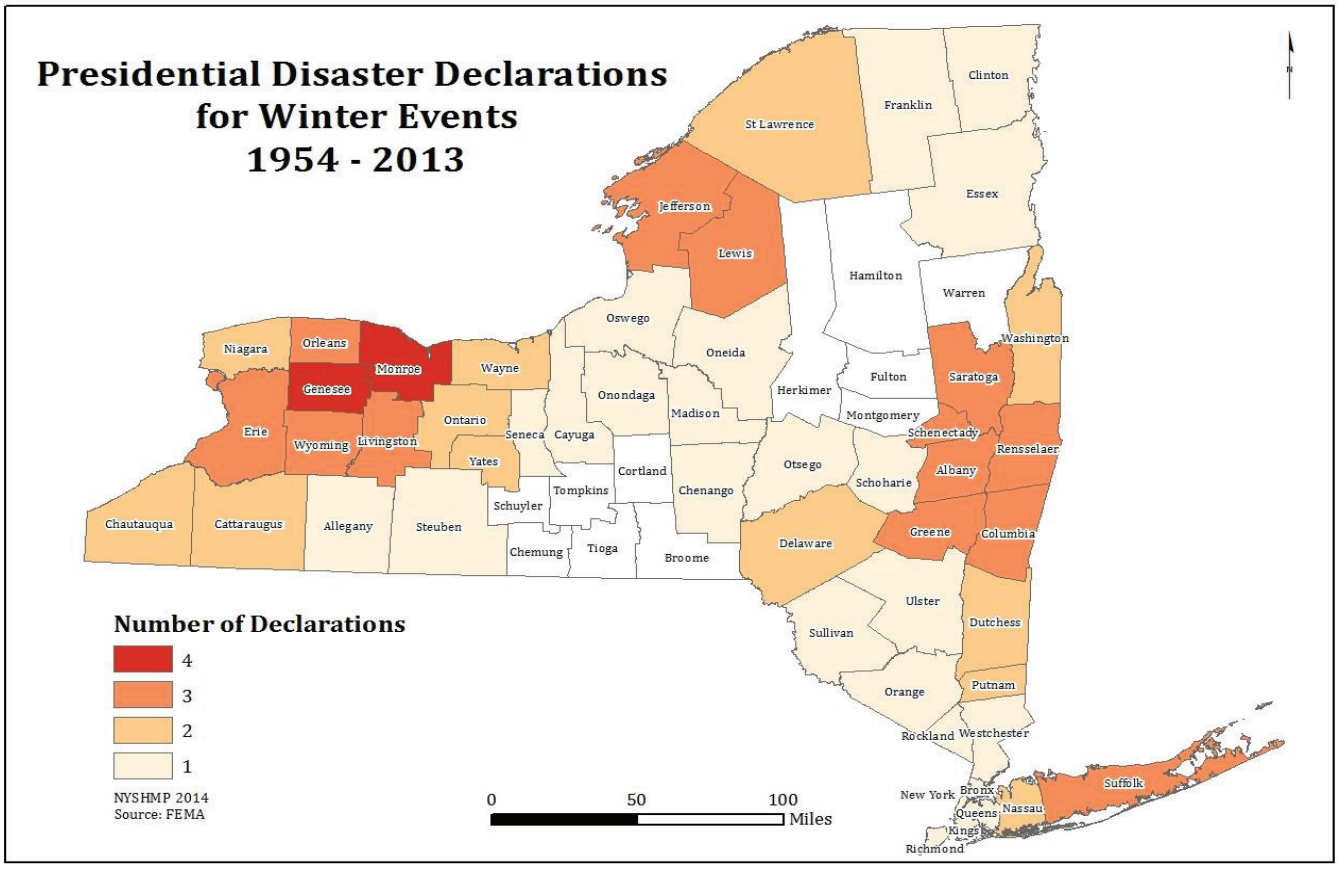
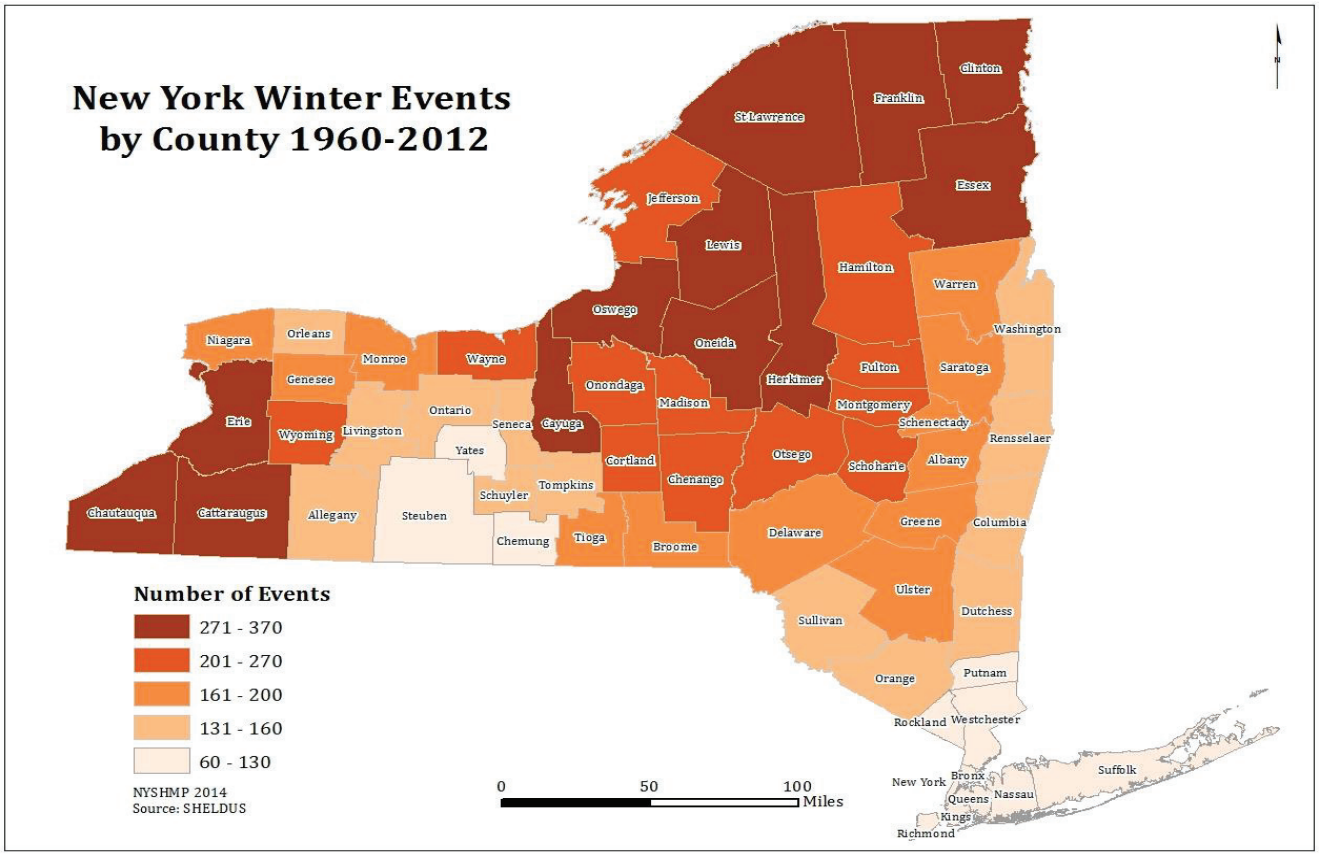


**Figure 3.15c: New York Winter Events by County 1960-2012**



SHELDUS data reports 11,876 severe winter storm event occurrences throughout New York State from 1960 to 2012; with property damage exceeding $1.7 billion. Additionally, 327 storm events occurred in 26 out of 62 counties from 2010-2012; property damage was approximately $4.2 million. From 1960 to 2012, 503 fatalities occurred, 2,560 injuries were reported, and crop damage exceeded $27 million. **Table 3.15c** represents historical and recent severe winter storm events and losses.

**Table 3.15c: Historical and Recent Severe Winter Storm Events and Losses**

| | Historical Record (1960 2012) | | | | | | | Recent Record (2010 2012) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County | Future Probability% | Recurrence Interval | No. of Events | Fatalities | Injuries | Property Damage | Crop Damage | No. of Events | Fatalities | Injuries | Property Damage | Crop Damage |
| **Albany** | 375 | 0.27 | 195 | 11 | 60 | $48,308,713 | $222,108 | 10 | 0 | 0 | $165,000 | $40,000 |
| **Allegany** | 290 | 0.34 | 151 | 4 | 7 | $14,585,332 | $49,259 | 0 | 0 | 0 | $0 | $0 |
| **Bronx** | 125 | 0.80 | 65 | 4 | 25 | $3,187,310 | $23 | 1 | 0 | 0 | $0 | $0 |
| **Broome** | 335 | 0.30 | 174 | 8 | 49 | $22,342,815 | $892,969 | 0 | 0 | 0 | $0 | $0 |
| **Cattaraugus** | 538 | 0.19 | 280 | 11 | 8 | $18,871,011 | $99,259 | 16 | 0 | 0 | $363,000 | $60,000 |
| **Cayuga** | 533 | 0.19 | 277 | 6 | 21 | $17,199,331 | $964,898 | 11 | 0 | 0 | $153,000 | $0 |
| **Chautauqua** | 581 | 0.17 | 302 | 7 | 11 | $20,008,714 | $139,259 | 14 | 0 | 0 | $228,000 | $100,000 |
| **Chemung** | 250 | 0.40 | 130 | 4 | 8 | $3,608,059 | $9,259 | 0 | 0 | 0 | $0 | $0 |
| **Chenango** | 423 | 0.24 | 220 | 6 | 51 | $24,948,711 | $226,610 | 0 | 0 | 0 | $0 | $0 |
| **Clinton** | 610 | 0.16 | 317 | 5 | 30 | $24,244,805 | $1,147,345 | 31 | 0 | 0 | $320,000 | $125,000 |
| **Columbia** | 294 | 0.34 | 153 | 10 | 62 | $50,487,953 | $228,458 | 0 | 0 | 0 | $0 | $0 |
| **Cortland** | 452 | 0.22 | 235 | 8 | 60 | $24,354,205 | $216,610 | 0 | 0 | 0 | $0 | $0 |
| **Delaware** | 350 | 0.29 | 182 | 8 | 81 | $50,062,019 | $892,969 | 0 | 0 | 0 | $0 | $0 |
| **Dutchess** | 302 | 0.33 | 157 | 16 | 67 | $49,255,537 | $892,742 | 0 | 0 | 0 | $0 | $0 |
| **Erie** | 573 | 0.17 | 298 | 11 | 12 | $57,206,821 | $74,259 | 18 | 0 | 0 | $385,000 | $40,000 |
| **Essex** | 627 | 0.16 | 326 | 3 | 35 | $24,292,489 | $1,077,901 | 33 | 0 | 0 | $282,000 | $50,000 |
| **Franklin** | 623 | 0.16 | 324 | 4 | 35 | $24,451,784 | $1,097,345 | 31 | 0 | 0 | $231,000 | $75,000 |

| | Historical Record (1960 2012) | | | | | | | Recent Record (2010 2012) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County | Future Probability% | Recurrence Interval | No. of Events | Fatalities | Injuries | Property Damage | Crop Damage | No. of Events | Fatalities | Injuries | Property Damage | Crop Damage |
| **Fulton** | 427 | 0.23 | 222 | 11 | 76 | $23,434,361 | $221,897 | 0 | 0 | 0 | $0 | $0 |
| **Genesee** | 352 | 0.28 | 183 | 8 | 6 | $55,135,364 | $964,815 | 4 | 0 | 0 | $60,000 | $0 |
| **Greene** | 342 | 0.29 | 178 | 6 | 65 | $48,721,694 | $178,708 | 1 | 1 | 1 | $0 | $0 |
| **Hamilton** | 460 | 0.22 | 239 | 8 | 76 | $24,492,612 | $1,047,751 | 0 | 0 | 0 | $0 | $0 |
| **Herkimer** | 529 | 0.19 | 275 | 14 | 93 | $53,224,195 | $1,059,923 | 0 | 0 | 0 | $0 | $0 |
| **Jefferson** | 527 | 0.19 | 274 | 5 | 25 | $23,762,578 | $215,926 | 14 | 0 | 0 | $180,000 | $40,000 |
| **Kings** | 123 | 0.81 | 64 | 4 | 31 | $3,178,727 | $23 | 1 | 0 | 0 | $0 | $0 |
| **Lewis** | 637 | 0.16 | 331 | 5 | 16 | $20,118,702 | $251,770 | 23 | 0 | 0 | $326,000 | $38,000 |
| **Livingston** | 296 | 0.34 | 154 | 4 | 7 | $26,404,955 | $1,114,815 | 7 | 0 | 0 | $115,000 | $50,000 |
| **Madison** | 502 | 0.20 | 261 | 13 | 95 | $27,409,298 | $226,673 | 0 | 0 | 0 | $0 | $0 |
| **Monroe** | 363 | 0.28 | 189 | 12 | 8 | $58,982,826 | $1,064,815 | 7 | 0 | 0 | $125,000 | $0 |
| **Montgomery** | 427 | 0.23 | 222 | 11 | 84 | $51,797,855 | $221,897 | 0 | 0 | 0 | $0 | $0 |
| **Nassau** | 125 | 0.80 | 65 | 6 | 25 | $3,178,727 | $23 | 0 | 0 | 0 | $0 | $0 |
| **New York** | 117 | 0.85 | 61 | 31 | 25 | $3,178,227 | $23 | 2 | 0 | 0 | $0 | $0 |
| **Niagara** | 346 | 0.29 | 180 | 9 | 9 | $52,395,560 | $989,815 | 6 | 0 | 0 | $95,000 | $0 |
| **Oneida** | 610 | 0.16 | 317 | 31 | 109 | $27,749,142 | $226,589 | 0 | 0 | 0 | $0 | $0 |
| **Onondaga** | 410 | 0.24 | 213 | 7 | 23 | $9,246,255 | $47,186 | 0 | 0 | 0 | $0 | $0 |
| **Ontario** | 296 | 0.34 | 154 | 5 | 6 | $18,037,569 | $1,114,815 | 6 | 0 | 0 | $65,000 | $50,000 |
| **Orange** | 260 | 0.39 | 135 | 13 | 66 | $51,378,251 | $892,994 | 1 | 1 | 1 | $0 | $0 |
| **Orleans** | 319 | 0.31 | 166 | 8 | 6 | $48,866,215 | $964,815 | 5 | 0 | 0 | $85,000 | $0 |
| **Oswego** | 715 | 0.14 | 372 | 6 | 13 | $20,448,562 | $1,146,481 | 21 | 0 | 0 | $483,000 | $15,000 |
| **Otsego** | 487 | 0.21 | 253 | 14 | 87 | $27,456,976 | $231,673 | 0 | 0 | 0 | $0 | $0 |
| **Putnam** | 238 | 0.42 | 124 | 5 | 63 | $48,963,490 | $892,744 | 0 | 0 | 0 | $0 | $0 |

| | Historical Record (1960 2012) | | | | | | | Recent Record (2010 2012) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County | Future Probability% | Recurrence Interval | No. of Events | Fatalities | Injuries | Property Damage | Crop Damage | No. of Events | Fatalities | Injuries | Property Damage | Crop Damage |
| **Queens** | 125 | 0.80 | 65 | 5 | 40 | $3,178,727 | $23 | 1 | 0 | 0 | $0 | $0 |
| **Rensselaer** | 281 | 0.36 | 146 | 6 | 52 | $47,911,109 | $184,014 | 0 | 0 | 0 | $0 | $0 |
| **Richmond** | 115 | 0.87 | 60 | 4 | 26 | $3,173,231 | $23 | 0 | 0 | 0 | $0 | $0 |
| **Rockland** | 160 | 0.63 | 83 | 4 | 32 | $31,256,617 | $9,284 | 0 | 0 | 0 | $0 | $0 |
| **Saratoga** | 390 | 0.26 | 203 | 8 | 142 | $49,126,368 | $221,858 | 0 | 0 | 0 | $0 | $0 |
| **Schenectady** | 375 | 0.27 | 195 | 7 | 60 | $48,351,389 | $221,858 | 0 | 0 | 0 | $0 | $0 |
| **Schoharie** | 437 | 0.23 | 227 | 8 | 78 | $24,508,827 | $216,592 | 0 | 0 | 0 | $0 | $0 |
| **Schuyler** | 256 | 0.39 | 133 | 4 | 10 | $8,412,743 | $9,259 | 0 | 0 | 0 | $0 | $0 |
| **Seneca** | 287 | 0.35 | 149 | 4 | 12 | $8,322,264 | $9,259 | 0 | 0 | 0 | $0 | $0 |
| **St Lawrence** | 719 | 0.14 | 374 | 10 | 44 | $26,565,519 | $1,272,343 | 43 | 0 | 0 | $297,000 | $250,000 |
| **Steuben** | 225 | 0.44 | 117 | 5 | 7 | $11,182,784 | $9,259 | 0 | 0 | 0 | $0 | $0 |
| **Suffolk** | 135 | 0.74 | 70 | 12 | 51 | $3,235,509 | $23 | 0 | 0 | 0 | $0 | $0 |
| **Sullivan** | 273 | 0.37 | 142 | 3 | 42 | $47,891,131 | $892,969 | 0 | 0 | 0 | $0 | $0 |
| **Tioga** | 354 | 0.28 | 184 | 5 | 42 | $24,516,058 | $892,969 | 0 | 0 | 0 | $0 | $0 |
| **Tompkins** | 275 | 0.36 | 143 | 7 | 13 | $5,708,247 | $9,259 | 0 | 0 | 0 | $0 | $0 |
| **Ulster** | 337 | 0.30 | 175 | 12 | 67 | $49,207,868 | $178,708 | 0 | 0 | 0 | $0 | $0 |
| **Warren** | 365 | 0.27 | 190 | 5 | 63 | $47,673,307 | $219,684 | 0 | 0 | 0 | $0 | $0 |
| **Washington** | 294 | 0.34 | 153 | 8 | 55 | $47,331,119 | $181,840 | 0 | 0 | 0 | $0 | $0 |
| **Wayne** | 438 | 0.23 | 228 | 7 | 11 | $25,269,775 | $1,064,815 | 8 | 0 | 0 | $155,000 | $0 |
| **Westchester** | 171 | 0.58 | 89 | 5 | 65 | $31,362,912 | $25 | 0 | 0 | 0 | $0 | $0 |
| **Wyoming** | 421 | 0.24 | 219 | 6 | 7 | $19,629,080 | $59,259 | 12 | 0 | 0 | $167,000 | $50,000 |
| **Yates** | 217 | 0.46 | 113 | 4 | 7 | $16,085,802 | $109,259 | 0 | 0 | 0 | $0 | $0 |

*Source: SHELDUS, 2013*

A significant winter storm generally occurs over more than a single day, with two days being common and three days being rare. They can cause significant damage, for instance, in March 1991, in western New York, a severe winter storm caused heavy ice accumulation on tree branches, bending or breaking limbs and tree boles, or toppling trees. The resulting tree debris disrupted power lines, blocked roads, and damaged residential and commercial property. Subsequent disturbance can also occur when broken limbs or whole trees can suddenly break and fall. These "widow makers" are high priority for removal after the event to prevent personal injury.

Damage from the January 1998 ice storm event was extensive across northern New York, northern New England and Canada. Over 17 million acres were impacted, with 5 million acres experiencing severe damage. The combination of cold surface temperatures, warm air aloft, and several days of rain contributed to the accumulation of more than four inches of ice in some areas. Hardwoods suffered the greatest damage, as was evident in the areas with many sugar maple trees. The magnitude of power disruption, debris removal, emergency tree pruning and removal, and the resulting loss of the resources were unprecedented. Further, the weakening of tree limbs during the storm left open the possibility of similar damage from future weather related events.

## Historical Winter Storm Events

### Winter Storm Nemo – February 8-9, 2013

By February 9, 2013 Winter Storm Nemo dropped more than 12 inches of snow on Suffolk County. Upstate New York encountered 10-12 inches of snow in the Hudson Valley and Adirondacks, 12 inches fell in Rochester, and 8 inches in Buffalo. Approximately 10,000 homes and businesses lost power on Long Island. Several vehicles were stranded on the Long Island Expressway overnight and police had to use snowmobiles to reach fire trucks, ambulances, police vehicles, and some snowplow trucks to rescue passengers. Roofs, weighed down by the snow, collapsed at a bowling alley and a home in Suffolk County; however, no one was injured. Winter Storm Nemo claimed two lives.

*Photo of Central Park New York, Blizzard of Feb. 2010; www.panoramio.com*

### Blizzard of 2010 – December 26, 2010

On December 26, 2010, a Nor'easter dropped more than 20 inches of snow on New York City. Strong winds pushed the falling snow into drifts that measured up to four feet. Transportation suffered major delays as airports and rail shut down across the city and Long Island. Travelers driving home from the holidays got stuck in the snow and abandoned their vehicles. These abandoned vehicles made it difficult for the city's plows to clear the accumulating snow. The 2010-2011 winter went on to be one of the snowiest on record, with 56.1 inches falling in January 2011 alone.

After the storm, OEM introduced a Snow Emergency Declaration to caution residents against unnecessary driving during a snowstorm and keep roads clear for plows and emergency vehicles.

### Ice and Snowstorm – December 11-12, 2008

The precipitation came down heavy December 11th. By December 12th, ice accumulations ranged from around half of an inch up to an inch across portions of the Capital District and the Berkshires. Snowfall reports ranged from 2 to 4 inches just north and west of the Capital District, where sleet mixed in along with lesser ice accumulations, up to 8 to 12 inches across portions of the southern Adirondacks. Widespread tree and power line damage across the local area causing power outages across East Central New York. More than 60,000 customers were out of power December 15th and power was not restored to 10,000+ customers until December 18th.

### Snow Storm – February 13, 2007

A low pressure system developed over the southern plains on February 12th, and intensified rapidly as it neared the East Coast on the night of the 13th. The storm then continued to strengthen as it moved up the Atlantic Seaboard during the day on February 14th. The storm spread snow into central New York beginning the evening of Tuesday, the 13th. The snow continued heavy at times through the 14th and gradually tapered off to snow showers on the 15th as the storm pulled northeast past the Gulf of Maine. Some sleet mixed with the snow for brief periods of time. The snow became heavy with near blizzard conditions at times over the Finger Lakes and central southern tier of New York during the early morning hours of the 14th. The heavy snow and near blizzard conditions shifted east to the upper Susquehanna Region of New York and western Mohawk Valley by the afternoon and evening of the 14th. Gusty winds to 40 mph developed behind the storm late on the 14th and through the 15th which led to considerable blowing and drifting snow. This hampered snow plowing and snow cleanup operations. As a result, many roads and highways were closed during the height of the snowstorm. Many counties and municipalities declared snow emergencies. Storm total snowfall amounts across much of central New York ranged between 15 and 30 inches. Less snow fell in Sullivan County, New York where more sleet was reported. This kept snowfall amounts down between 8 and 12 inches in this area. The heaviest snowfall from this storm occurred in Delaware and Otsego

counties where between 2 and 3 feet was common. The highest snowfall was reported in Roseboom where 39 inches of snow occurred and Springfield where 38 inches fell. The weight of the snow caused several roofs to collapse.

### Snow and Ice Storm – April 4, 2003

A stationary front was west to east across Pennsylvania during the 3rd and 4th of April. Areas of low pressure moved along the front bringing precipitation to upstate New York. A large area of high pressure, centered over Hudson Bay Canada helped to keep cold air at the surface. The morning of the 5th low pressure moved northeast to Erie, Pennsylvania then to northeast New York that evening. A trailing cold front brought with it an end to the precipitation from west to east. Patchy freezing rain was across these counties first the night of the 3rd into the 4th. At this time the freezing rain was most widespread in Northern Oneida County. Steady widespread freezing rain started during the day of the 4th across Oneida, Onondaga, and Madison Counties. During the evening of the 4th colder air spread further south into the Finger Lakes and northern Susquehanna Region. This changed moderate rain to freezing rain in these areas especially at the higher elevations. Across northern Oneida County the freezing rain changed to snow. The snow accumulated up to five inches. Ice accumulations were mostly a quarter to half an inch with a few locations up to an inch. The Schuyler County Emergency Manager reported an inch of ice across most of the county. Tens of thousands of electricity customers were without power, some for up to a week. States of emergencies were declared for most of these counties.

### Winter Storm – March 6, 1996

A winter storm formed over the Carolinas and tracked up the coast, bringing heavy snow to central New York. Snowfall accumulations ranged from 6 to 12 inches by the time the snow tapered off on the evening of the 7th. During the height of the storm, many accidents were reported due to poor visibility, including one in which an elderly couple was killed and one person injured in a collision in Lansing (Tompkins County). In Onondaga County, one man was killed and one injured in a two-car accident in Marcellus. Two people were injured near Rome in Oneida County when their car drove off the road, and six people were injured in Homer, Cortland County, when a tour bus drove off Interstate 81 in near zero visibility.

*The Blizzard of 1993; http://photos.syracuse.com/post-standard/2009/03/the_blizzard_of_1993_10.html*

### Blizzard of 1993 – March 14-15, 1993

This blizzard virtually shut down eastern New York on March 13th and 14th. Also, record snows fell

from the Southern Tier of New York to the Catskills. In addition to the heavy snow, high winds damaged structures and caused almost 200,000 power outages across the state. An avalanche in the Catskills buried a county snow plow.

### The Downslope Nor'easter – December 10-12, 1992

This storm produced incredible snowfall totals across many mountainous locations, while barely having any effect on valley locations. Strong east winds caused the air to "downslope" off the Berkshires and Taconics, and "dry it out." Snowfall totals in the Berkshires ranged from 30 to 48 inches with drifts up to 12 feet. Schools were closed for a week and the National Guard had to bring in heavy equipment to remove the snow. The Catskills and Helderbergs also got their share of snow with 18 to 39 inches reported. On Friday, December 11, at the height of the storm, the city of Albany received a half inch of snow with temperatures in the middle 30's. Albany did eventually get 6", but most of that fell toward the end of the storm, on Saturday the 12th, after the winds turned more northerly.

### Surprise October Snowstorm – October 4, 1987

The highest snowfall that ever fell in Albany in the month of October; heavy, extreme wet snow fell on fully leaved trees. Fallen trees and down power lines blocked roads and damaged homes. The extreme devastation left residents without power for up to two weeks.

### January Snowstorm of 1983 – January 15-16, 1983

Eastern New York was severely impacted by this storm. High accumulation of snow halted travel across the area. Several auto accidents with injure were documented. Albany reported 24.5 inches of snow and Saratoga County reported less than 30 inches.

### Blizzard of 1978 - February 6-7, 1978

This storm affected Long Island and eastern New York. The storm produced strong wind causing snow drifts; snow was reported up to 25 inches.

### Thanksgiving Snowstorm of 1971 – November 24, 1971

Thanksgiving Eve snow fell and continued into the next day. Numerous travelers were stranded on the busiest travel day of the year. The City of Albany picked up 22.5 inches; other areas of New York reported up to 30 inches of snow.

### Post-Christmas Snowstorm of 1969 – December 25-28-1969

Christmas night Albany encountered a storm system moving northward along the east coast. The storm moved inland for a short period then headed back to sea December 28th

causing heavy, wet snowfall mixed with freezing rain. Snow removal was a challenge; streets were not cleared for up to four weeks. A total of 26.7 inches fell making this the third greatest storm on record.

### Blizzard of 1966 – January 29-31, 1966

This storm is known for its blizzard conditions from intense lake squalls that developed as arctic air streamed across Lake Ontario. Oswego County reported 75 inches, with some unofficial reports of around 100 inches in that vicinity. Rome, which is approximately 75 miles from Lake Ontario, received 41 inches and Albany County received a foot of snow over a two day period.

### Worst Snow Storm on Record – December 4-5, 1964

Freezing rain caused ice accumulations of up to 1.5 inches paralyzing east central New York. Residents had no power for up to two weeks and schools were shut down for a week. The State incurred damages close to $5 million.

### Blizzard of 1958 – February 5-16, 1958

A Nor'easter blew 30 inches of snow across the Catskills dropping 17.9 inches in Albany. Snow blocked the majority of roadways making travel impossible. Cattle were stranded; helicopters dropped food to them, in Operation "Haylift".

### Great Appalachian Storm – November 24-25, 1950

Rain and snow were associated with this storm; however, wind gusts were recorded in Albany up to 83 mph, with sustained winds of 50-60 mph. Two very high pressure centers produced an extremely tight pressure gradient, one east of Labrador and the other over the Mississippi Valley. Wind damage was critical in New York State causing downed power lines and trees throughout the region. The state incurred damage totaling more than 20 million dollars.


*Blizzard of 1888, New York City's 11th Street; http://myinwood.net/a-buried-city-the-blizzard-of-1888/*

### Blizzard of 1888 – March 11-14, 1888

All blizzards are measured by this event. It was considered the "worst storm in living memory in the northeast". The City of Albany was shut down. There was no heat, road closures, and doctors were unable to make house calls. Light snow began mid-afternoon March 11th accumulating to 3 inches by midnight. Snow intensified

overnight, accumulating 18 inches of snow by day break. Total snowfall by March 14th was 46.7 inches, the drifts were significantly higher.

## Probability of Future Winter Storm Events

Severe winter storm events in New York State are virtually guaranteed yearly since the State is located at relatively high latitudes resulting in winter temperatures that range between 0°F and 32°F for a good deal of the fall through early spring season (late October until mid-April). Additionally, the State is exposed to large quantities of moisture from both the Great Lakes and the Atlantic Ocean. While it is almost certain that a number of significant winter storms will occur during the winter and fall season, what is not easily determined is how many such storms will occur during that time frame.

NYS uses Hazards New York (HAZNY) as its methodology to rank natural and man-made disasters, which focuses on preparedness and response; for the purpose of mitigation NYS uses a modified version of HAZNY to rank hazards in relation to their potential for mitigation. Based on **Table 3.2a in Section 3.2,** the HAZNY-Mitigation hazard ranking table; local jurisdictions rank severe winter storms as a low risk hazard. Mitigation activities such as, plowing snow, salting roadways and maintaining trees for severe winter storms are handled at the local level.

According to the data provided in **Table 3.15b**, Historical and Recent Severe Winter Storm Events and Losses, the counties with the highest probability for future occurrences are noted in **Table 3.15d.**

### Table 3.15d: Future Probability of Severe Winter Storm Events

| County | Future Probability (%) |
|---|---|
| St. Lawrence | 719 |
| Oswego | 715 |
| Lewis | 637 |
| Essex | 627 |
| Franklin | 623 |
| Clinton | 610 |
| Oneida | 610 |

**Justification for Minimal Vulnerability/Loss Assessment**

Severe Winter Storm occurrences in New York State are typically regional in scale; and, while past occurrences have resulted in loss of life, the scale of impacts and consequences are isolated compared to flood and hurricane events, and are typically within the capabilities of the impacted jurisdictions to prepare, respond, and recover. Severe Winter Storm was ranked as "low" with a HAZNY-Mitigation score of 18, based on severity of impact and mitigation potential. (Section 3.0 describes the hazard ranking methodology used to determine this finding.) Therefore, it is determined that there is not sufficient evidence that Severe Winter Storm has a high level of overall risk to population and property that has potential for mitigation to justify further analysis for the 2014 Plan update.

The information provided in the Risk Assessment sections below serves as guidance for impact and consequence analysis and local hazard mitigation planning.

## 3.15.2 Assessing Winter Storm Vulnerability and Estimating Potential Losses by Jurisdiction

According to the NOAA National Severe Storms Laboratory (NSSL); every year, winter weather indirectly and deceptively kills hundreds of people in the U.S., primarily from automobile accidents, overexertion and exposure. Winter storms are often accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, drifting snow and extreme cold temperatures and dangerous wind chill. They are considered deceptive killers because most deaths and other impacts or losses are indirectly related to the storm. People can die in traffic accidents on icy roads, heart attacks while shoveling snow, or of hypothermia from prolonged exposure to cold. Heavy accumulations of ice can bring down trees and power lines, disabling electric power and communications for days or weeks. Heavy snow can immobilize a region and paralyze a city, shutting down all air and rail transportation and disrupting medical and emergency services. Storms near the coast can cause coastal flooding and beach erosion as well as sink ships at sea. The economic impact of winter weather each year is huge, with costs for snow removal, damage and loss of business in the millions (NSSL, 2006).

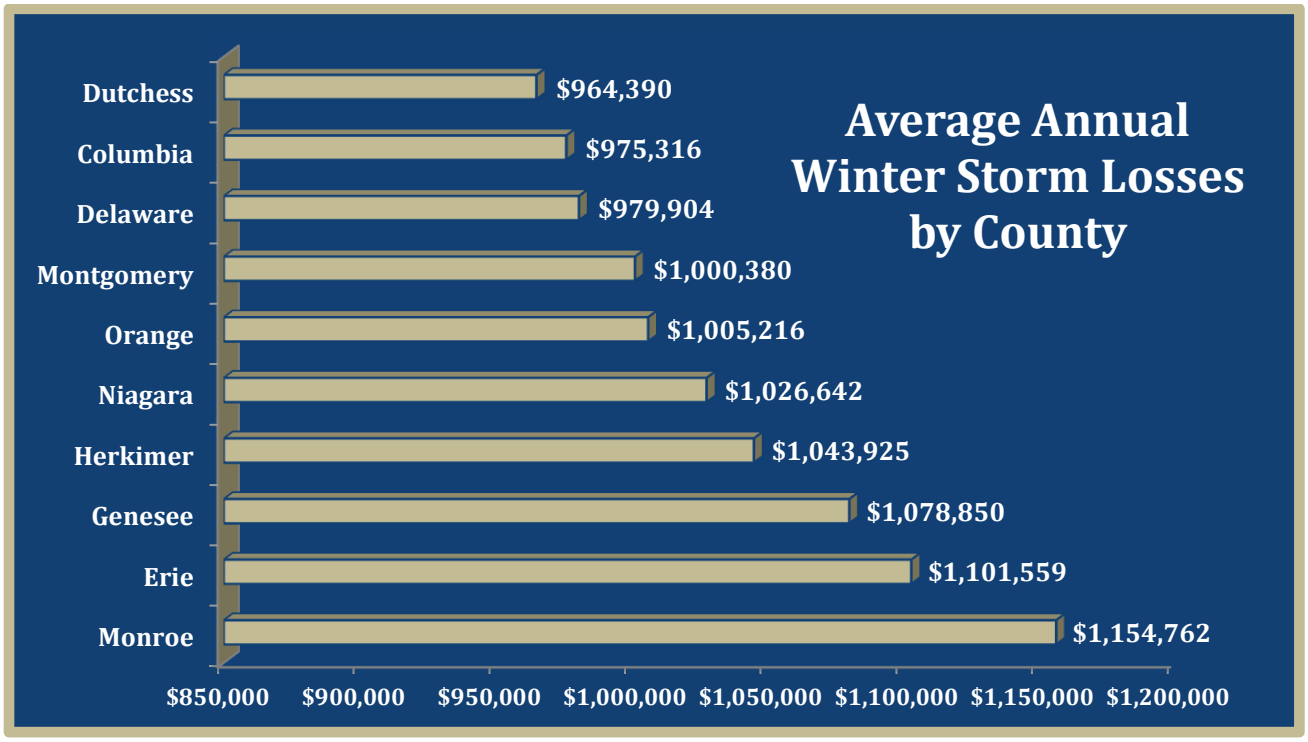
**Table 3.15e** provides the annualized losses for severe winter storm events. The data used was based on SHELDUS records from 1960-2012, with the exception of hurricane, earthquake, and flood hazards which were derived from HAZUS-MH 2.1. For those specific hazards, a probabilistic run was generated to determine the total annual losses for each county found within the State. The information provided by SHELDUS was determined by taking the total economic losses divided by the number of years of record (52) to obtain the losses per year. **Figure 3.15d,** illustrates the top ten counties annualized losses with a total of $34,845,157 in severe winter storm losses for the entire State of New York.

## Table 3.15e: Average Annual Severe Winter Storm Losses by County 1960-2012

| County | Winter Storm | County | Winter Storm | County | Winter Storm |
|---|---|---|---|---|---|
| Monroe | $ 1,154,762 | Westchester | $ 603,133 | Chautauqua | $ 387,461 |
| Erie | $ 1,101,559 | Rockland | $ 601,267 | Wyoming | $ 378,622 |
| Genesee | $ 1,078,850 | Oneida | $ 537,995 | Ontario | $ 368,315 |
| Herkimer | $ 1,043,925 | St Lawrence | $ 535,344 | Cattaraugus | $ 364,813 |
| Niagara | $ 1,026,642 | Otsego | $ 532,474 | Cayuga | $ 349,312 |
| Orange | $ 1,005,216 | Madison | $ 531,461 | Yates | $ 311,443 |
| Montgomery | $ 1,000,380 | Livingston | $ 529,226 | Allegany | $ 281,434 |
| Delaware | $ 979,904 | Wayne | $ 506,434 | Steuben | $ 215,232 |
| Columbia | $ 975,316 | Franklin | $ 491,329 | Onondaga | $ 178,720 |
| Dutchess | $ 964,390 | Hamilton | $ 491,161 | Schuyler | $ 161,962 |
| Putnam | $ 958,774 | Tioga | $ 488,635 | Seneca | $ 160,222 |
| Orleans | $ 958,289 | Clinton | $ 488,311 | Tompkins | $ 109,952 |
| Ulster | $ 949,742 | Essex | $ 487,892 | Chemung | $ 69,564 |
| Saratoga | $ 949,004 | Chenango | $ 484,141 | Suffolk | $ 62,222 |
| Greene | $ 940,392 | Schoharie | $ 475,489 | Bronx | $ 61,295 |
| Sullivan | $ 938,156 | Cortland | $ 472,516 | Kings | $ 61,130 |
| Schenectady | $ 934,101 | Jefferson | $ 461,125 | Nassau | $ 61,130 |
| Albany | $ 933,285 | Fulton | $ 454,928 | Queens | $ 61,130 |
| Rensselaer | $ 924,906 | Broome | $ 446,842 | New York | $ 61,120 |
| Warren | $ 921,019 | Oswego | $ 415,289 | Richmond | $ 61,024 |
| Washington | $ 913,711 | Lewis | $ 391,740 | **Total** | **$34,845,157** |

*Source: SHELDUS, 2013*

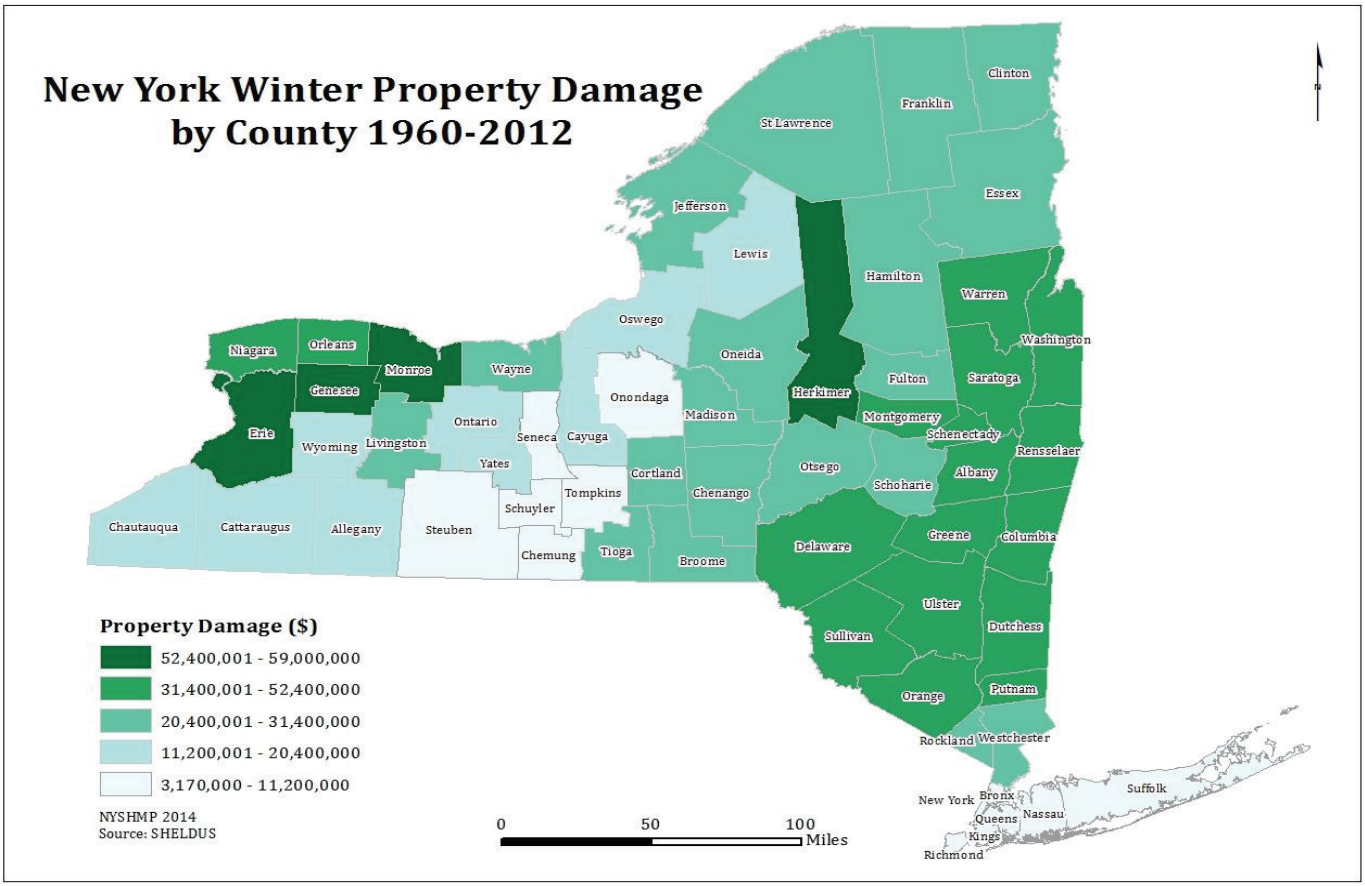
**Figure 3.15d: Average Annual Severe Winter Storm Losses by County 1960-2012**




*Source: SHELDUS, 2013*

Over the past 52 years 11,876 severe winter storm events occurred throughout NYS. Counties reporting the highest amount of property damage were Monroe, Erie, Genesee, Herkimer, and Niagara collectively exceeding more than $276 million in property damage. **Figure 3.15e** shows the total cost of property damage caused by severe winter storm events from 1960-2012.

**Figure 3.15e: New York Winter Property Damage by County 1960-2012**



Based on the historical and recent severe winter storm events and loss data assessed by the NYS mitigation team all 62 New York State counties have been affected by severe winter storm events over the past 52 years.

### Tables 3.15f: Summary of Winter Storm Hazard Impacts and Rankings by County

| Local County Winter Storm Hazard Impacts | | |
|---|---|---|
| **Highest Occurrences** | **Highest Fatalities** | **Highest Property Damage** |
| St. Lawrence | Oneida | Monroe |
| Oswego | New York | Erie |
| Lewis | Dutchess | Genesee |
| Essex | Otsego | Herkimer |
| Franklin | Herkimer | Niagara |

*Source: SHELDUS*

| Local County Winter Storm Hazard Rankings | |
|---|---|
| **High** | **Moderately High** |
| Broome, Cayuga, Franklin, Fulton, Greene, Montgomery, Orleans, Saratoga, Suffolk, and Tioga | Albany, Allegany, Cattaraugus, Delaware, Essex, Jefferson, Lewis, Madison, Monroe, Onondaga, Ontario, Oswego, Otsego, Rensselaer, Schenectady, Seneca, Sullivan, Ulster, Warren, Wayne, and Wyoming |

*Source: LHMP*

## Development in hazard prone areas

NYS will always be vulnerable to severe winter events; because of its geographic location. Leading up to the winter months, the State does focus on preparedness and response, but mitigation strategies and measures are developed and executed by each local jurisdiction.

On the local level, economic impact may be felt by increased consumption of heating fuel, which can lead to energy shortages and higher prices. House fires and resulting deaths tend to occur more frequently from increased and improper use of alternate heating sources. Fires during these events also present a greater danger because water supplies may freeze and impede firefighting efforts.

Additional, heavy snow can immobilize a region and paralyze a city, stranding commuters, stopping the flow of supplies, and disrupting emergency and medical services. Accumulations of snow can collapse buildings and knock down trees and power lines. In rural areas, homes and farms may be isolated for days, and unprotected livestock may be lost. In the mountains, heavy snow can lead to avalanches. The cost of snow removal, repairing damages, and loss of business can have large economic impacts on cities and towns. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles

and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage. Even small accumulations of ice may cause extreme hazards to motorists and pedestrians. Bridges and overpasses are particularly dangerous because they freeze before other surfaces (NSSL, 2006).

Because severe winter storms are not limited to geographic boundaries or population groups, it is difficult to identify development and population trends that impact this hazard. Current NYS land use and building codes incorporate standards that address and mitigate snow accumulation. Several local jurisdictions have implemented the following activities to eliminate loss of life and damage to property and infrastructure during the severe winter events:

- Remove snow from roadways.
- Remove dead trees and trim trees/brush from road ways to lessen falling limbs and trees.
- Ensure proper road signage is visible and installed properly.
- Bury electrical and telephone utility lines to minimize downed lines.
- Remove debris/obstructions in waterways and develop routine inspections/maintenance plans to reduce potential flooding.
- Replace substandard roofs of critical facilities (such as hospitals) to reduce exposure to airborne germs resulting from leakage.
- Purchase and install backup generators in evacuation facilities and critical facilities to essential services to residents.
- Install cell towers in areas where limited telecommunication is available to increase emergency response efforts and cell phone coverage.

### Statewide Winter Storm Preparedness Maintenance Program

NYS does maintain State highways for accessibility during winter events. The New York State Thruway Authority (Authority) implements its aggressive winter maintenance program. During periods of inclement winter weather the program's goal is to provide customers a roadway that is safely drivable at reasonable speeds, with the ultimate goal of returning to bare pavement as quickly as possible. Each fall the New York State Thruway Authority (Authority) implements its aggressive winter maintenance program. During periods of inclement winter weather the program's goal is to provide customers a roadway that is safely drivable at reasonable speeds, with the ultimate goal of returning to bare pavement as quickly as possible.

*Source: New York State Thruway Authority*

Winter preparations begin in the spring

with the start of the Authority's annual preventive maintenance program on all plow trucks and winter maintenance equipment. Further preparations include renewing or establishing salt contracts, procuring needed equipment and supplies, and ensuring a trained and adequately staffed workforce.

The Authority's four Divisions: New York, Albany, Syracuse and Buffalo are tasked with the operational response to winter weather events. Each of the Authority's 21 maintenance locations is responsible for snow and ice operations over approximately 30 miles of roadway, as well as the accompanying interchanges, service areas and related facilities. Operations are set to achieve approximately one hour cycle times for plowing and spreading the roadway, although this can vary substantially due to traffic, weather and other factors.

The Authority has approximately 200 large plow trucks to plow snow and to disperse salt. In addition, each location also has a complement of smaller plow trucks and other ancillary equipment such as front-end loaders and skid steer mounted snowblowers. Every piece of equipment undergoes a thorough preventive maintenance service between each winter season. These efforts are generally completed by late October. By the start of the winter schedule, all material spreaders are mounted on trucks and calibration for proper salt application rates is complete. Additionally, the Authority owns five large truck mounted snowblowers. These units are stationed strategically across the system and relocated as forecasts and conditions dictate. In addition, there are 15 smaller skid steer mounted snowblowers that are used for more routine snow removal needs.

The Authority's primary weapon to fight roadway icing is rock salt. The average annual usage for the past ten years is approximately 180,000 tons. The Authority's 38 storage locations provide for the secure covered storage of approximately 128,100 tons of salt. Sheds are filled prior to the start of winter and salt is reordered as usage occurs throughout the season. With dedicated Authority salt contracts and timely ordering to replenish stockpiles, adequate salt supplies are guaranteed absent the most severe of winters.

In addition to rock salt, the Authority utilizes straight salt brine and a beet brine mixture in both an anti-icing application and as a pre-treatment for the rock salt. Other liquids such as calcium chloride and magnesium chloride are utilized to improve effectiveness at lower temperatures. This program demonstrates the State's role and capabilities in preparedness and response to winter storm events.

### 3.15.3 Assessing Winter Storm Vulnerability of State Facilities

Found in **Section 3.1.6** is a full description of the current status and data limitations to state-owned facilities and critical infrastructures for New York State.

A comprehensive analysis of state facilities has not been undertaken for this hazard in the 2014 update; the 2011 plan provides a methodology and data for a gross estimate of

potential snow losses to identified vulnerable State facilities in terms of dollar value of exposed property. While the data in **Table 3.38: State Facilities – Assessing Vulnerability and Estimating Loss for Snow Hazard** (see 2014 Plan Update, **Appendix 3, Attachment A: Data Supplement**) is not current, the process followed to create a GIS layer for State facilities using the coordinate information and overlay onto a snow hazard layer developed using NOAA NCDC annual average snowfall data is still valid. The intention of this analysis was to assess vulnerability and provide an aggregate exposure of State facilities as a proxy for a potential loss estimate. The analysis methodology had limitations for complete accuracy, and applicability of the results was not considered to be highly reliable beyond a general indication. Instead, the analysis results and process may best be used as a guide to help target those facilities that might benefit from further analysis and is, consequently, included in the 2014 update.

Unlike flood or earthquake hazard, there are no standard loss estimation models or methodologies for the snow hazard. A preliminary dollar loss estimate could have been calculated based on known information such as total structures for general occupancy class, indicated higher snow hazard areas (average annual and extreme snowfall potential map and data) as determined earlier in this plan, and use of residential structure dollar value estimates. However, many assumptions and generalizations would need to be made for several unknowns.

Unknowns or data that are available but not prepared or analyzed include: inventory estimates of the more vulnerable structures such as those pre-building code structures, flat roof structures, and historical or critical structures, and the type of damage and dollar damage figures. The many generalizations and guess work would result in figures with little accuracy, and potentially misleading indications of a jurisdiction's vulnerability and potential loss to the snow hazard. Therefore, this version of the NYS risk assessment instead includes an identification of needed data and establishes actions necessary to gather data needed to estimate potential losses. As local mitigation plans with snow hazard risk assessment data become available, this information will be incorporated into a state risk assessment repository for integration into future vulnerability analyses. Additionally, application of GIS technology will continue, including exploring the possibility of obtaining and incorporating certain data that may better define the high hazard area characteristics such as more comprehensive snowfall extremes data, and real property data layers in support of future snow hazard vulnerability analysis.

## 3.15.4 Data Limitations, Sources and Key Documents

The profile outlined in this section has been developed from the following sources:

- Northeast Regional Climate Center (NRCC) based at Cornell University, *http://nysc.eas.cornell.edu/climate_of_ny.html*
- NOAA Satellite and Information Services and National Climate Data Center, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
- NYS Emergency Management Office (NYSEMO), www.dhses.ny.gov
- National Weather Service's Cooperative Observer Program (COOP), www.nws.noaa.gov/om/coop
- New York State Thruway Authority, www.thruway.ny.gov/
- Federal Emergency Management Agency (FEMA), www.fema.gov
- Kocin, P. J. and L. W. Uccellini, 2004: A Snowfall Impact Scale Derived From Northeast Storm Snowfall Distributions. *Bull. Amer. Meteor. Soc.*, 85, 177-194
- Squires, M. F. and J. H. Lawrimore, 2006: Development of an Operational Snowfall Impact Scale. 22nd IIPS, Atlanta, GA.
- Spatial Hazard Events and Losses Databases for the United States (SHELDUS)

***Please Note:*** *Data obtained from the Spatial Hazard Events and Losses Database for the United States (SHELDUS™). SHELDUS is a county-level hazard data set for the U.S. for 18 different natural hazard event types such thunderstorms, hurricanes, floods, and tornados. For each event the database includes the beginning date, location (county and state), property losses, crop losses, injuries, and fatalities that affected each county. The data derives from the national data source, National Climatic Data Center's monthly Storm Data publications. Using the latest release of SHELDUS™ 12.0, the database includes every loss causing and/or deadly event between 1960 through 1992 and from 1995 onward. Between 1993 and 1995, SHELDUS™ reflects only events that caused at least one fatality or more than $50,000 in property or crop damages.*

**ATTACHMENT E**

# PENNDOT INCIDENT MANAGEMENT AFTER-ACTION REVIEW MEETING AGENDA

**Incident Management After-Action Review Meeting Agenda**

PennDOT Organization _____

Date: _____

Time : _____

Conference Call No.: _____

The purpose of this meeting is to discuss past response efforts and ways to improve response in the future.

Invited Attendees (Sample):

- PennDOT District Incident Management Coordinator
- PennDOT On-Scene Responder and/or Assistant County Maintenance Managers
- PennDOT Central Office Incident Management Coordinator (Optional, but provide a copy of the meeting minutes)
- PennDOT District Emergency Management Coordinator (Optional)
- PennDOT District TMC Manager or Traffic Engineer
- Pennsylvania State Police Incident Commander
- Pennsylvania State Police Trooper
- Pennsylvania State Police Bureau of Patrol (Optional)
- County Emergency Management Agency
- Fire Chief or Assistant (Optional)
- Local/Township Police (Optional)

1. Welcome/Attendance – PennDOT Facilitator

2. Report on Past Event(s)- Field Responders

- Identify field objectives for the event(s)
- Identify field issues –incident response/clearing, detour routes
- Identify TMC/agency support issues – incident detection/verification, motorist notification
- Identify good practices – from the issues above

3. Discuss Ways to Improve (consider the following) – All Responders and Agency Representatives

- Incident Detection
- Incident Information/Verification
- Incident Response/Clearance
- Notifying Motorists
- Detouring Vehicles

4. Open Discussion – PennDOT Facilitator/All

- Remaining Communications/Documentation Issues
- Remaining Equipment Needs
- Upcoming Training Requirements/Opportunities

- Other situational awareness or concerns
- Creation of New Action Items
- Next Meeting Date

After Action Report must be submitted to Central Office Incident Management Section for review and feedback.


research for winter highway maintenance

Lead state:

**Minnesota Department of Transportation**
Research Services
395 John Ireland Blvd.
St. Paul, MN 55155