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Best Practices for Road Weather Management

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PDH: 7

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Module 1: Introduction

Learning Objectives

By the end of this section, you will be able to:

- **Identify** the three primary categories of road weather management strategies.
- **Evaluate** the impact of adverse weather on safety, mobility, and productivity within transportation networks.
- **Select** appropriate mitigation strategies based on specific environmental threats.

Executive Summary: Weather impacts on surface transportation are significant, contributing to over 7,000 annual fatalities and disrupting roadway capacity; however, transportation managers can mitigate these effects through the targeted application of advisory, control, and treatment strategies.

The Impact of Weather on Transportation

Weather threats are a nationwide concern that fundamentally degrades the performance of surface transportation systems. These impacts are categorized into three critical areas:

Roadway Safety

- **Risk Elevation:** Adverse weather significantly increases crash risk and direct exposure to weather-related hazards.
- **Human Toll:** Approximately 7,130 fatalities and 629,000 injuries occur annually during inclement weather.

Roadway Mobility

- **Capacity and Volume:** Weather events reduce traffic volume throughput and roadway capacity, defined as the maximum rate at which vehicles can travel.
- **Travel Efficiency:** Mobility is hindered by increased travel time delays, reduced speeds, and increased **speed variance** (a lack of speed uniformity).

Productivity

- **Operational Costs:** Events increase road operating and maintenance costs.
- **Network Access:** Severe weather disrupts access to critical road networks, impacting economic throughput.

Road Weather Management Strategies

To counter environmental threats such as fog, high winds, snow, rain, ice, flooding, and severe storms, engineers utilize three distinct strategic types:



Advisory Strategies

Advisory strategies provide information on prevailing and predicted conditions to both transportation managers and motorists. These facilitate informed decision-making before and during travel.

Control Strategies

Control strategies alter the state of roadway devices to permit or restrict traffic flow and regulate roadway capacity. Examples often include variable speed limits or lane restrictions.

Treatment Strategies

Treatment strategies supply resources to roadways to minimize or eliminate weather impacts. These often require intensive coordination between traffic, maintenance, and emergency management agencies.

⚠ Safety Constraint: While there is a common perception that little can be done about weather-related accidents, engineers **shall** employ these mitigation strategies to actively reduce the high rate of fatalities and injuries observed during adverse conditions.

💡 Design Tip: When selecting a strategy, consider that treatment strategies often provide the most direct mitigation of physical hazards (like snow or ice) but require the highest level of inter-agency coordination.

Evolution of Practices

This course examines 27 state-of-the-art case studies from 22 states. While previous iterations of these guidelines covered older solutions, this current version focuses on practices that have either been mainstreamed or represent the latest advancements in the field.

Checkpoint Quiz

1. Which strategy type specifically involves changing the state of roadway devices to restrict traffic flow?
- a) Advisory Strategies
 - b) Treatment Strategies
 - c) Control Strategies
 - d) Productivity Strategies

Answer: (c). Control strategies alter the state of roadway devices to regulate roadway capacity or flow.



2. According to the text, how is "roadway capacity" defined?

- a) The measure of speed uniformity
- b) The maximum rate at which vehicles can travel
- c) The total number of lanes available for emergency use
- d) The percentage of salt successfully applied to a surface

Answer: (b). The text explicitly defines roadway capacity as the maximum rate at which vehicles can travel.

3. True or False: Advisory strategies are intended solely for transportation managers to help them plan maintenance schedules.

- a) True
- b) False

Answer: (b). Advisory strategies provide information to both transportation managers and motorists.



Module 2: Alabama DOT Low Visibility Warning System

Learning Objectives

By the end of this section, you will be able to:

- **Identify** the core hardware and communication components of an integrated fog detection and warning system.
- **Select** appropriate advisory and control strategies based on visibility distance thresholds.
- **Evaluate** implementation challenges related to sensor technology and roadway infrastructure constraints.

Executive Summary: Prompted by a 193-vehicle crash on the Interstate 10 Bay Bridge, the Alabama DOT deployed a low-visibility warning system that integrates forward-scatter visibility sensors, radar vehicle detection, and centralized traffic management to dynamically adjust speed limits and motorist advisories during fog events.

System Components

The system operates along the seven-mile Bay Bridge and is integrated with a nearby tunnel management system. Key components include:

- **Visibility Detection:** Six sensors using **forward-scatter technology** are installed at roughly one-mile intervals along the bridge to measure visibility distance.
- **Traffic Surveillance:** A network of 25 **Closed Circuit Television (CCTV)** cameras provides live video feeds to monitors in the Traffic Management Center (TMC).
- **Vehicle Detection:** **Radar Vehicle Detection (RVD)** devices are positioned every one-third of a mile to monitor traffic flow.
- **Control Devices:** The system manages 24 **Variable Speed Limit (VSL)** signs and five **Dynamic Message Signs (DMS)** to regulate traffic and inform motorists.
- **Communications:** Field data is transmitted via a fiber optic system, upgraded in 2008 from point-to-point communication to **Ethernet**.

System Operations

The TMC is staffed 24 hours a day by at least two **Automated Transportation System (ATS) Operators**. When operators observe fog via CCTV, they consult the central computer for visibility measurements across six independent zones.

Advisory and Control Strategies

Based on visibility conditions, operators execute specific strategies as outlined in Table AL-1:

Table AL-1. Low Visibility Warning System Strategies

Visibility Distance	Advisories on DMS	Other Strategies
Less than 900 feet (274.3 meters)	“FOG WARNING”	Speed limit at 65 mph (104.5 kph)
Less than 660 feet (201.2 meters)	“FOG” alternating with “SLOW, USE LOW BEAMS”	“55 MPH” (88.4 kph) on VSL signs; “TRUCKS KEEP RIGHT” on DMS
Less than 450 feet (137.2 meters)	“FOG” alternating with “SLOW, USE LOW BEAMS”	“45 MPH” (72.4 kph) on VSL signs; “TRUCKS KEEP RIGHT” on DMS
Less than 280 feet (85.3 meters)	“DENSE FOG” alternating with “SLOW, USE LOW BEAMS”	“35 MPH” (56.3 kph) on VSL signs; “TRUCKS KEEP RIGHT” on DMS; Street lighting extinguished
Less than 175 feet (53.3 meters)	“I-10 CLOSED, KEEP RIGHT, EXIT”	1/2 mile road closure by Highway Patrol

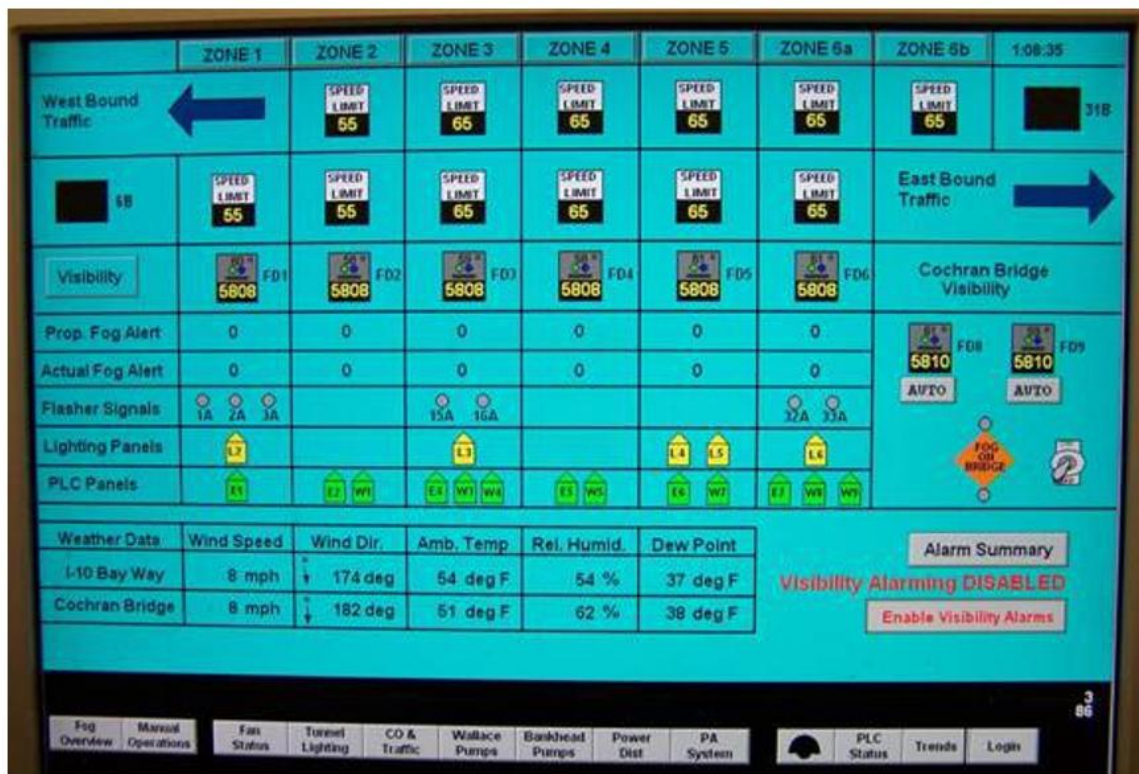


Figure AL-1: Screen Shot of Low Visibility Warning System.

⚠ Safety Constraint: When speed limits are reduced, operators shall ensure notices are automatically faxed to the DOT Division Office, Highway Patrol, and local law enforcement in neighboring jurisdictions like Mobile, Daphne, and Spanish Ford.

💡 Design Tip: For extreme conditions, utilize **vehicle guidance** operations where a patrol vehicle with flashing lights leads traffic across the bridge at a safe speed to prevent multi-vehicle pile-ups.



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