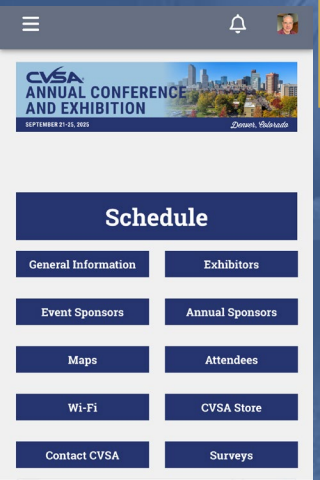
NAFMP
North American Fatigue Management Program

Anatomy of Six Fatigue Crashes
Lessons Learned for All Motor Carriers

Annual Conference and Exhibition
Denver, Colorado
September 22, 2025



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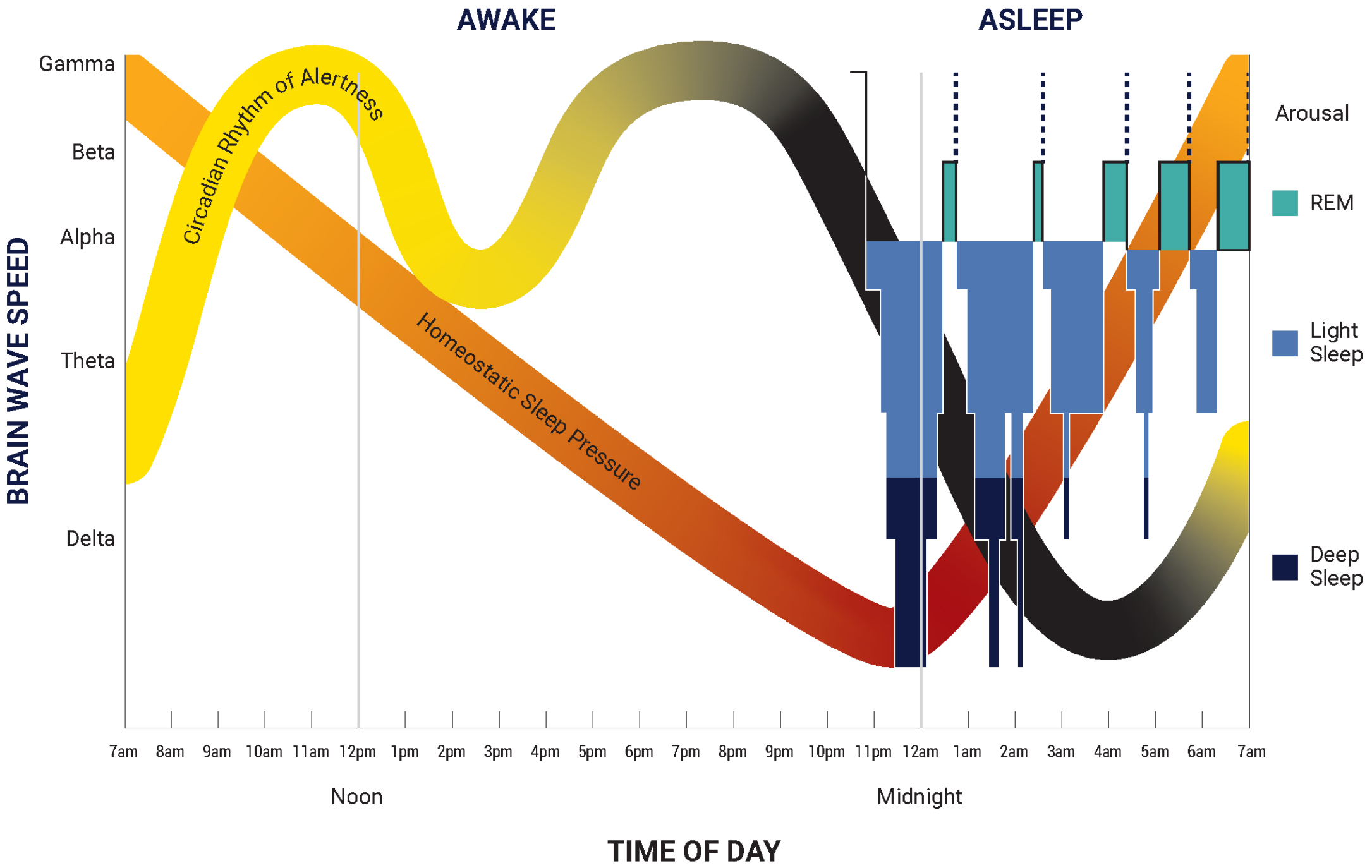
Overview

1. Sleep Science Glasses
2. Physiological Factors of Scheduling
3. Anatomy of Six Crashes
    1. Facts
    2. Probable Cause
    3. Safety Issues
    4. NTSB Lessons and recommendations
4. How to Mitigate Fatigue Crash Risk
5. Questions and Contact

Sleep Science Glasses


AWAKE
ASLEEP
Gamma
Beta
Alpha
Theta
Delta
BRAIN WAVE SPEED
Circadian Rhythm of Alertness
Homeostatic Sleep Pressure
Arousal
REM
Light Sleep
Deep Sleep
7am 8am 9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9pm 10pm 11pm 12am 1am 2am 3am 4am 5am 6am 7am
Noon
Midnight
TIME OF DAY

Physiological Factors

Time of Day

- The body's clock promotes daytime alertness and nighttime sleep
- Fatigue significantly increases when driving between midnight and 7 a.m., counteracting natural sleep cycles
- Extensive night driving leads to poorer quality daytime sleep, causing accumulated fatigue and reduced alertness
- Disregarding the body's clock impairs cognitive function, slows reactions, and raises crash risk

Recent Sleep

- Most individuals require 6 to 9 hours of sleep for optimal function
- Insufficient sleep in the last 24 hours is a significant contributor to fatigue
- Scheduling practices that consistently reduce sleep opportunity directly lead to this deprivation, impacting driver alertness

Continuous Hours Awake

- Being awake for more than 16 consecutive hours since the last major sleep period significantly increases fatigue
- This prolonged wakefulness is due to mounting homeostatic sleep pressure, dramatically impairing a driver's ability
- Poorly planned schedules often result in long hauls without adequate breaks, pushing drivers into this dangerous zone and increasing crash risk

Cumulative Sleep Debt

- Accumulated sleep debt must be repaid for optimal function
- More than eight hours of accumulated sleep debt since the last full night of sleep, including disrupted sleep, is a significant fatigue factor
- Schedules that offer inconsistent rest periods or force drivers to constantly "catch up" on sleep contribute to this chronic and dangerous fatigued state

Gradual Schedule Changes

- The body's circadian rhythm adapts slowly to changes in sleep-wake patterns
- When altering work schedules, it's ideal to do so gradually, by no more than 1-2 hours per week
- Drastically changing sleep-wake times overnight can cause significant desynchronization between the internal clock and the external environment
- This desynchronization exacerbates fatigue and impairs performance for several days until the body fully adjusts, highlighting the need for careful schedule transitions

Forward Schedule Changes are Easier

- The body generally adapts more easily to schedules that shift forward (e.g., going to bed and waking up later)
- Shifting forward allows homeostatic sleep pressure to accumulate, making it easier to fall asleep at a later time
- Conversely, shifting schedules backward (going to bed and waking up earlier) fights against existing sleep pressure, making it harder to fall asleep and potentially leading to accumulated sleep debt

Monotonous or Complex Task

- The nature of the driving task significantly influences fatigue levels
- Highly monotonous driving (e.g., long, straight highways) can lead to under-stimulation and boredom, increasing drowsiness
- Overly complex or demanding conditions (e.g., heavy traffic, adverse weather, intricate routes) can increase mental workload and cognitive fatigue
- Both extremes—monotony and complexity—require careful consideration in scheduling and rest planning to mitigate fatigue

Underlying Sleep Disorders

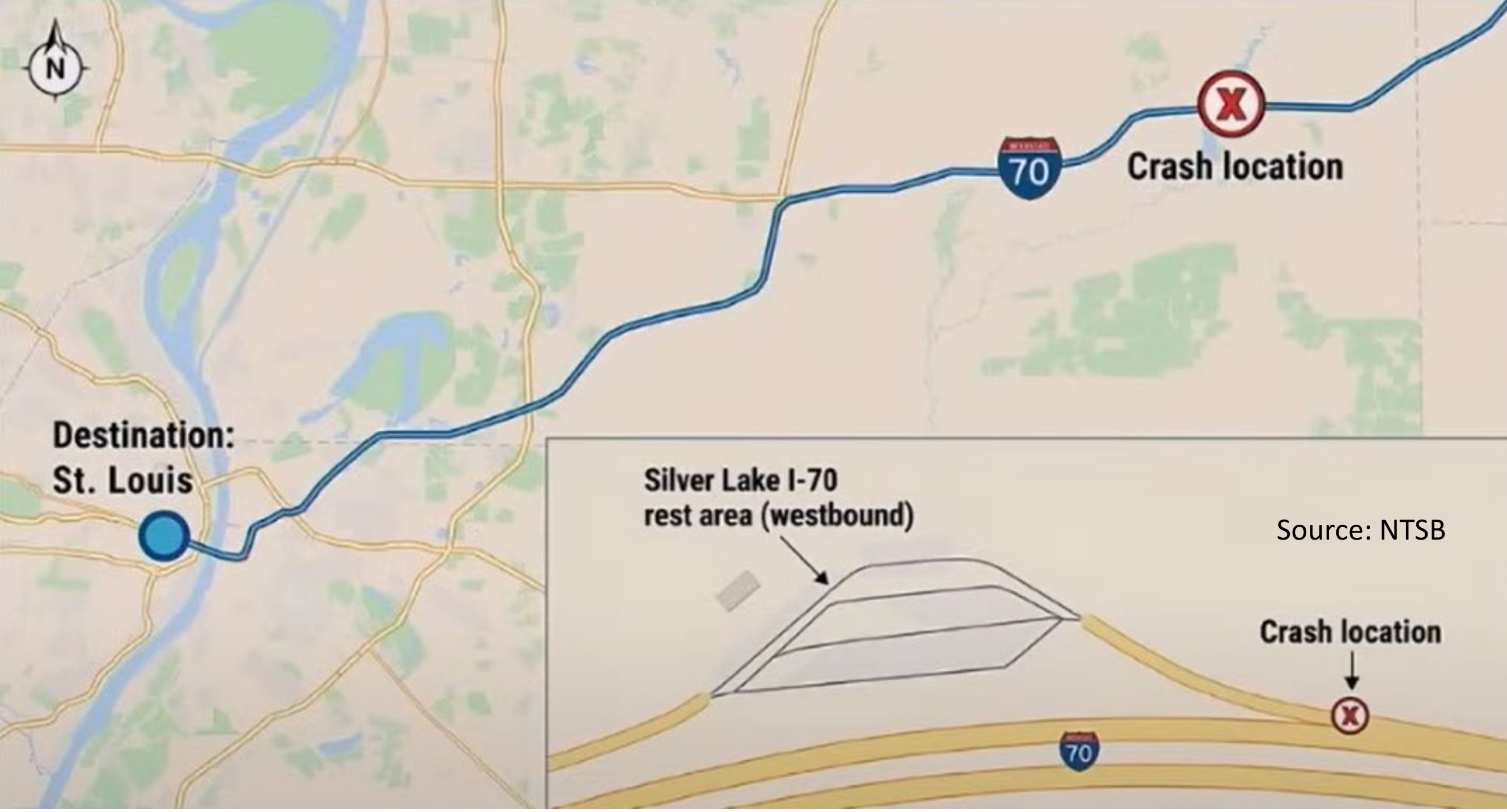
- Undiagnosed or untreated sleep disorders are significant contributors to chronic fatigue, even when sleep opportunities seem adequate
- Conditions like obstructive sleep apnea (OSA), characterized by repeated stops and starts in breathing during sleep, severely disrupt sleep quality
- This disruption leads to excessive daytime sleepiness, regardless of the time spent in bed
- Drivers with unmanaged sleep disorders face a heightened risk of fatigue-related incidents and require proper diagnosis and treatment to ensure road safety

1. Collision of Motorcoach with Combination Vehicles Parked Along Exit

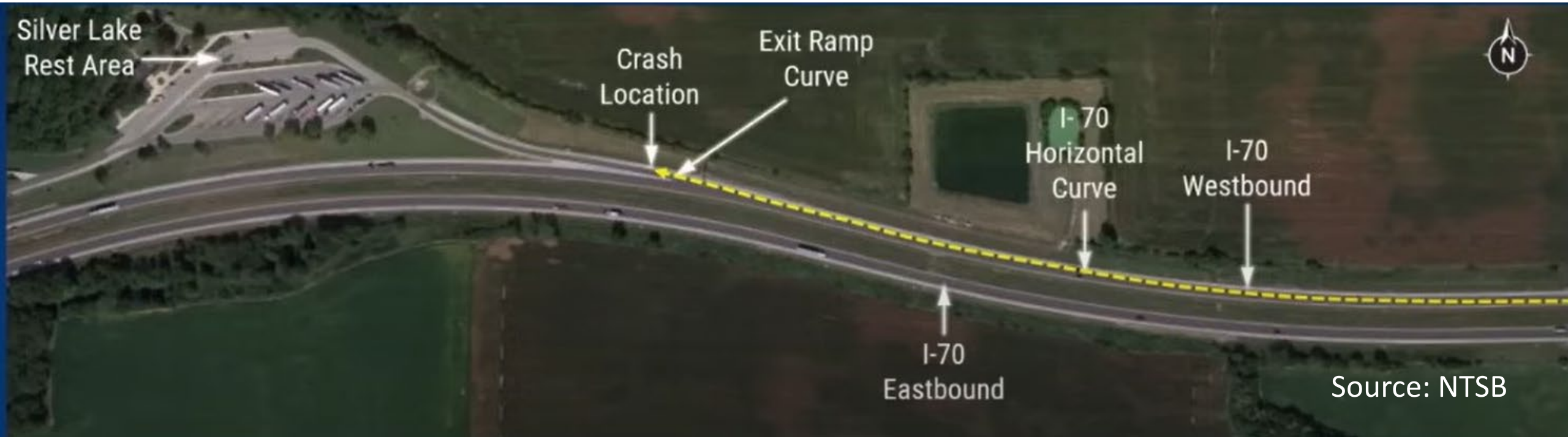
Facts

- At 1:48 a.m. July 12 2023, a motorcoach carrying 21 people veered off Interstate 70 near Highland, Illinois, colliding with three parked combination vehicles
- Three passengers died
- The driver and 11 other passengers sustained injuries of varying severity

Source: NTSB
https://www.ntsb.gov/investigations/Pages/HWY23MH015.aspx


N
70
Crash location
Destination:
St. Louis
Silver Lake I-70
rest area (westbound)
Crash location
70

Source: NTSB

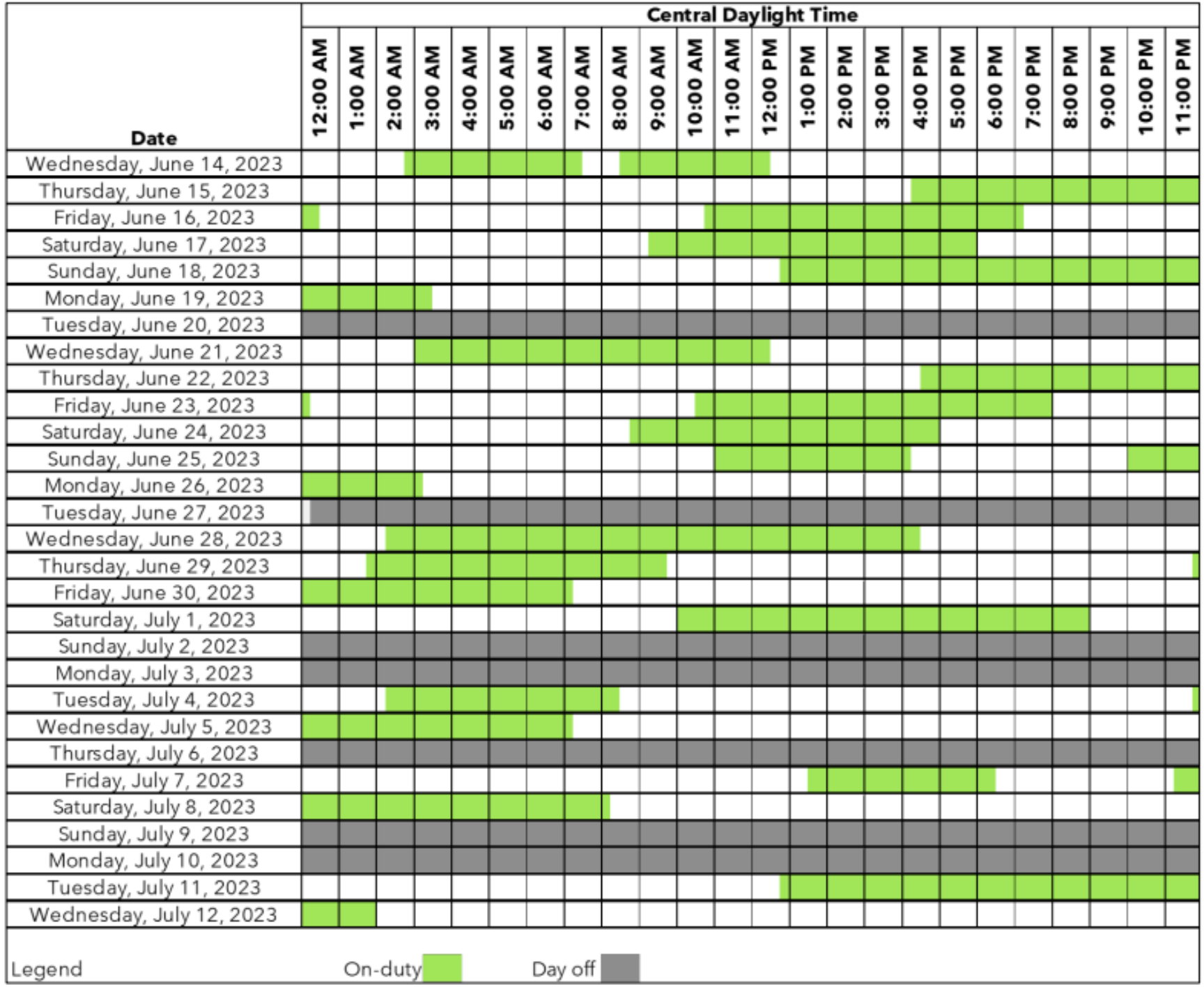

Silver Lake
Rest Area
Crash
Location
Exit Ramp
Curve
I- 70
Horizontal
Curve
I-70
Westbound
I-70
Eastbound
N
Source: NTSB


Mack
vehicle
Kenworth
vehicle
Source: NTSB
N
Prevost
motorcoach
Freightliner
vehicle

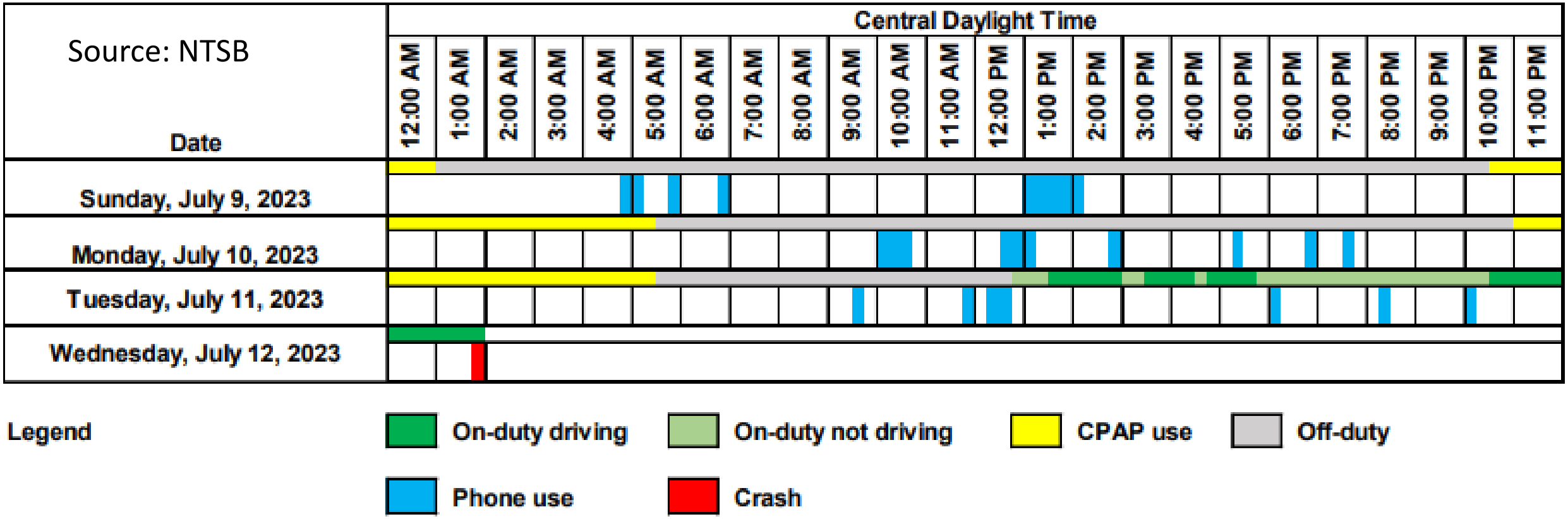

Mack combination unit
Kenworth combination unit
Prevost motorcoach
Freightliner combination unit
Direction of travel
N
Source: NTSB

Schedule

Source: NTSB



Schedule


Source: NTSB
Central Daylight Time
Date
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
Sunday, July 9, 2023
Monday, July 10, 2023
Tuesday, July 11, 2023
Wednesday, July 12, 2023
Legend
On-duty driving
On-duty not driving
CPAP use
Off-duty
Phone use
Crash

NTSB Probable Cause

- Driver's departure of the motorcoach from the travel lanes onto the shoulder of the exit ramp due to fatigue
- Contributing to the motorcoach driver's fatigue was his irregular work-rest schedule and prolonged time awake (17 hours, 13 on duty)
- Driver medical history
  - High blood pressure treated with one prescription medication
  - Diabetes treated with one prescription
  - High cholesterol treated with one prescription medication
  - Diagnosed with obesity
  - Obstructive sleep apnea (OSA) treated with a CPAP device
  - Diagnosed with confusion due to head injury with concussion sustained in a 2018 crash, documented persistent cognitive and behavioral symptoms and was given instructions for additional testing and neurology follow-up that did not occur

Safety Issues

- Operator fatigue due to the driver's work schedule
- Inadequate carrier oversight of its drivers, which included a lack of a progressive discipline policy, inadequate record-keeping, and the absence of a policy for monitoring systems
- Insufficient federal guidance on safety management, driver training, and fatigue mitigation
- Lack of seatbelt use by passengers, which contributed to the severity of injuries
- Increased risk of collisions due to the shortage of truck parking along the National Highway System

NTSB Lessons and Recommendations

- Implement a program to educate drivers and staff on fatigue and its countermeasures
- Adjust schedules to reduce irregular work-rest cycles
- Establish an electronic system for personnel files to improve access to driver records, including disciplinary actions
- Use data from monitoring systems to detect and prevent fatigue
- Define an acceptable number of safety violations and implement disciplinary measures for underperforming drivers
- Create a policy to assess the effectiveness of new safety policies and technologies after adoption
- Mandate a safety briefing before each departure, driver change, and when new passengers board

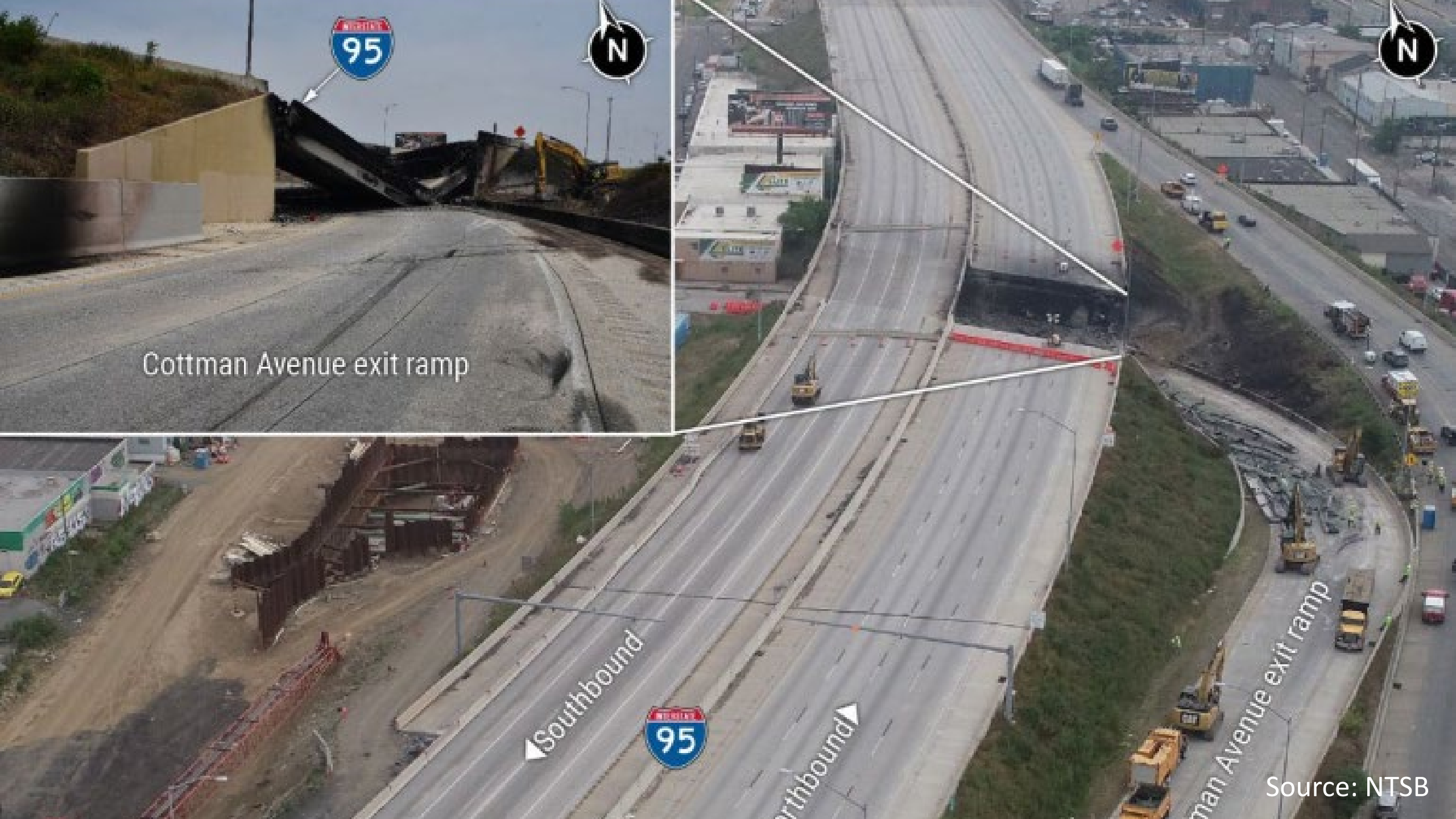
2. Combination Vehicle Rollover, Fire and Interstate 95 Overpass Collapse

Facts

- At 6:17 a.m. June 11 2023, a truck-tractor with a tank trailer carrying 8,500 gallons of gasoline crashed while exiting northbound I-95 in Philadelphia, Pennsylvania
- The driver lost control on a curved exit ramp, causing the truck to overturn and strike a concrete barrier
- The resulting fire destroyed the truck, caused the collapse of northbound I-95 lanes and fatally injured the truck driver

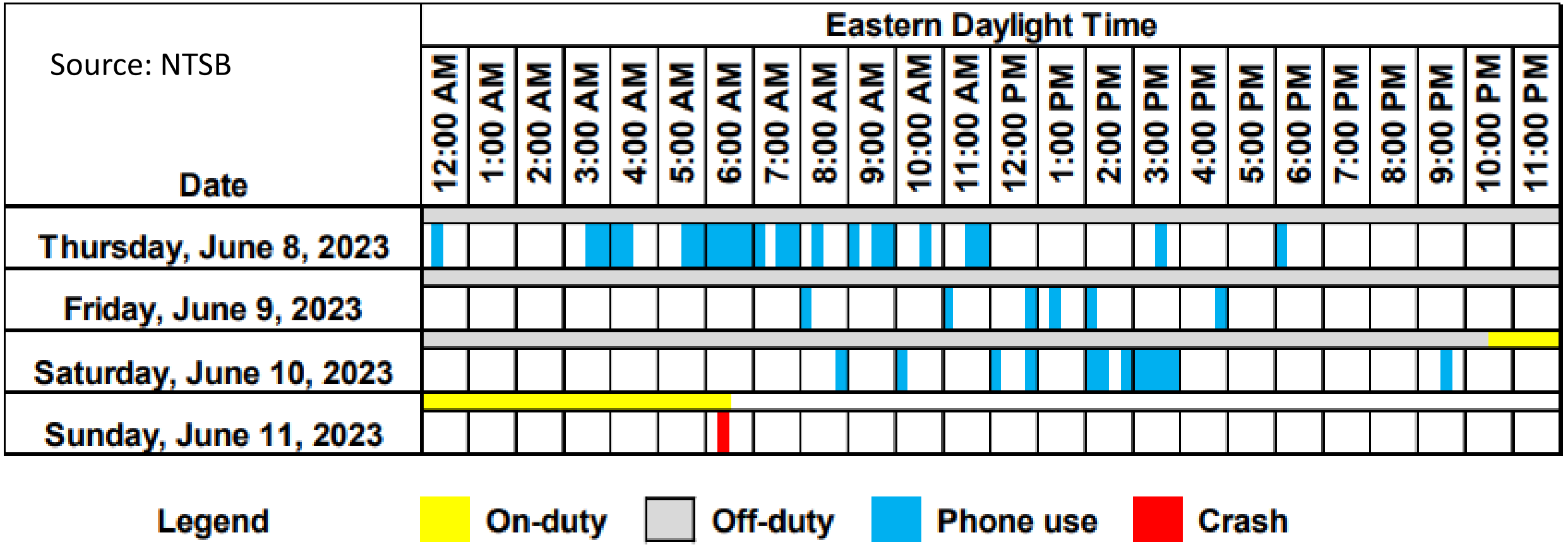
Source: NTSB

https://www.ntsb.gov/investigations/Pages/HWY23FH014.aspx


95
N
Cottman Avenue exit ramp
Southbound
95
N
Cottman Avenue exit ramp

Source: NTSB

Schedule


Source: NTSB
Eastern Daylight Time
Date
12:00 AM
1:00 AM
2:00 AM
3:00 AM
4:00 AM
5:00 AM
6:00 AM
7:00 AM
8:00 AM
9:00 AM
10:00 AM
11:00 AM
12:00 PM
1:00 PM
2:00 PM
3:00 PM
4:00 PM
5:00 PM
6:00 PM
7:00 PM
8:00 PM
9:00 PM
10:00 PM
11:00 PM
Thursday, June 8, 2023
Friday, June 9, 2023
Saturday, June 10, 2023
Sunday, June 11, 2023
Legend
On-duty
Off-duty
Phone use
Crash

NTSB Probable Cause

- Driver's failure to slow the vehicle as he exited the interstate onto the exit ramp well above the posted advisory speed limit due to inattention to the roadway potentially associated with fatigue
- Among the many strategies that a robust fatigue management program can promote, this crash highlights the importance of drivers adopting sleep schedules that do not change substantially between their workdays and their days off
- History of high blood pressure, no medications
- Toxicological testing postmortem detected diphenhydramine, a sedating over-the-counter antihistamine

Safety Issues

- Speeding on the off-ramp
- Driving with the manhole open
- Lack of vehicle electronic stability control

NTSB Lessons and Recommendations

- Implement fatigue management program as a critical measure to prevent collisions
- It is vital for drivers to maintain consistent sleep schedules on both work and non-workdays
- NTSB simulations indicated that an electronic stability control system would have prevented the truck from rolling over

3. Box Truck Centerline Crossover Collision with Bus

Facts

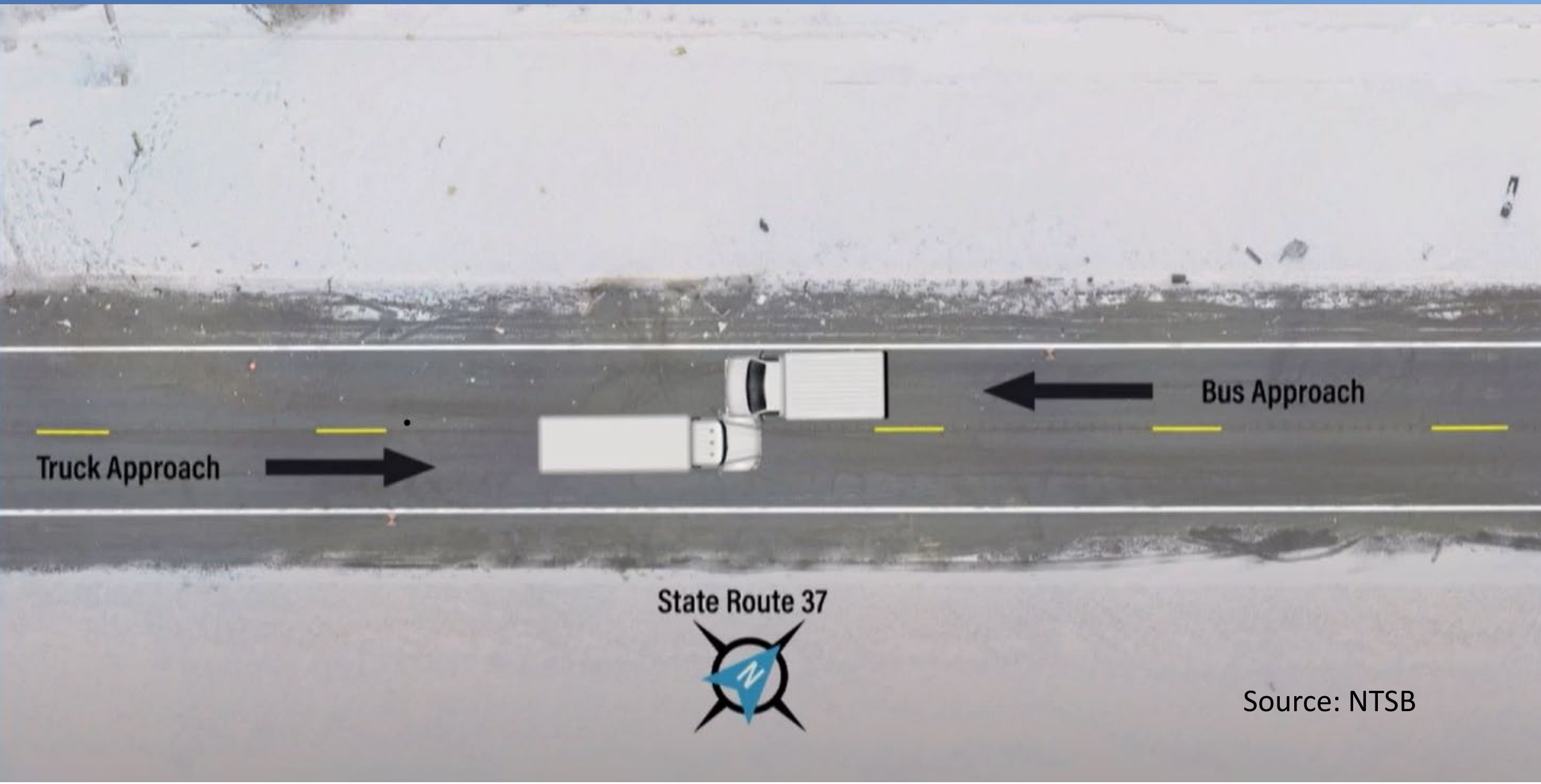
- At 6 a.m. Jan. 28 2023, a bus and a box truck collided head-on on New York State Route 37 in Louisville, New York
- The truck crossed the centerline striking the bus, which was transporting workers to a construction site
- This crash resulted in six fatalities, two serious injuries and five minor injuries among the bus passengers, along with minor injuries to the bus driver and serious injuries to the truck driver

Source: NTSB

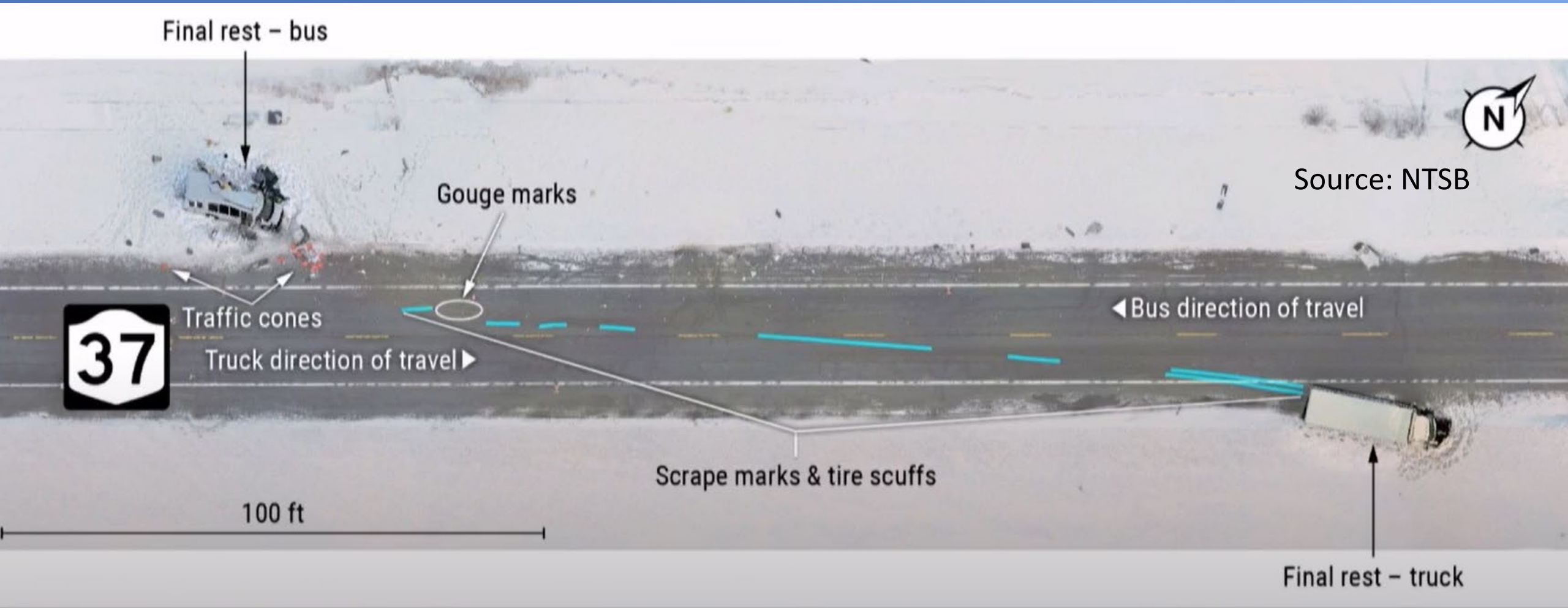
https://www.ntsb.gov/investigations/Pages/HWY23FH005.aspx


Canada
Crash location
United States
New York
VT
MA
CT
Pennsylvania
Canada
United States
St. Lawrence River
N
37
Bus direction of travel
Truck direction of travel
Crash location
Town of Louisville
New York
1 mi

Source: NTSB



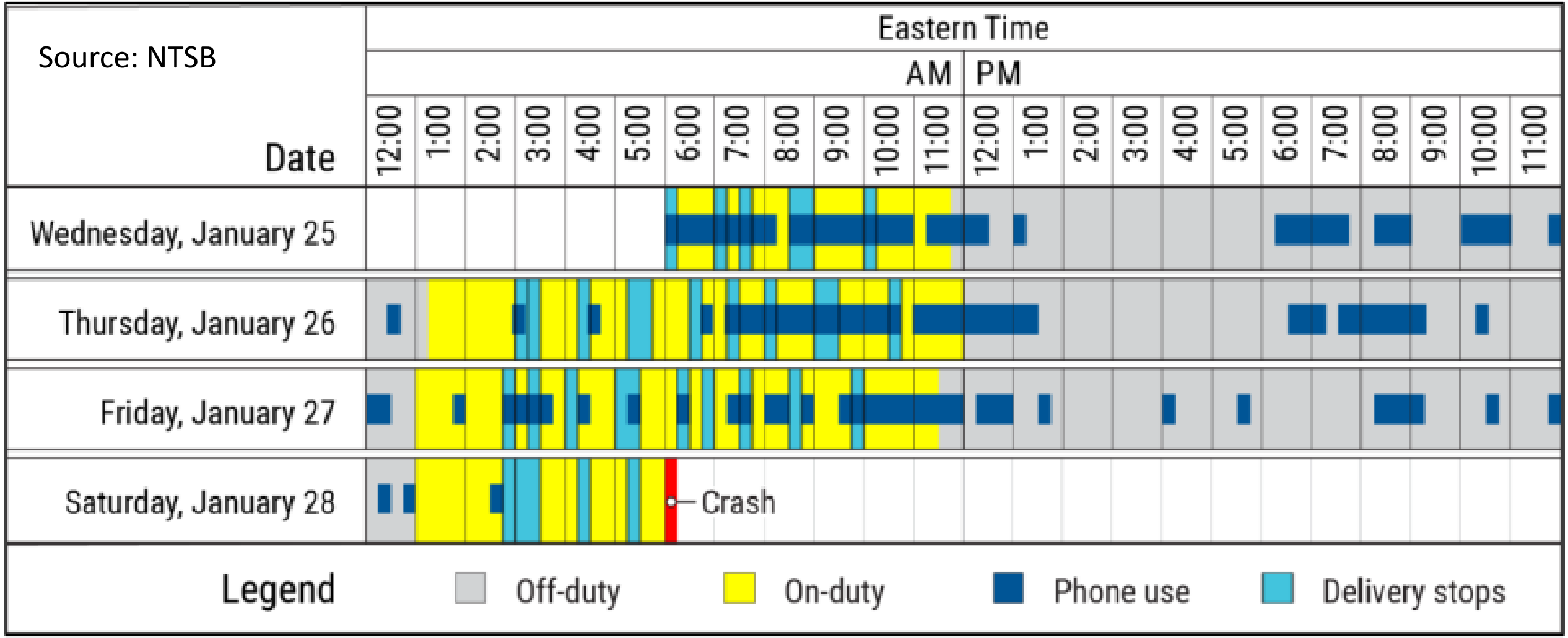
Source: NTSB


Final rest – bus
Gouge marks
Traffic cones
Truck direction of travel
37
Bus direction of travel
Scrape marks & tire scuffs
100 ft
Final rest – truck
N

Source: NTSB

Source: NTSB

Schedule


Source: NTSB
Eastern Time
AM
PM
Date
12:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
Wednesday, January 25
Thursday, January 26
Friday, January 27
Saturday, January 28
Crash
Legend
Off-duty
On-duty
Phone use
Delivery stops

NTSB Probable Cause

- Driver's fatigue due to insufficient sleep and circadian disruption, which lowered his level of alertness to the driving task and resulted in the truck crossing the centerline of the roadway into the opposing lane of travel and colliding with the oncoming bus
- Fatigue caused by limited and fragmented sleep as well as circadian disruption associated with his shift-work schedule
- No medical conditions

Safety Issues

- Truck driver fatigue led to a lane departure
- Contributing factors from the trucking company:
  - Had no fatigue management program
  - Did not have driver monitoring systems (DMS) installed
  - A lane departure warning system could have prevented or mitigated the crash
- Safety issues on the bus:
  - Passenger injuries were worsened because seat belts were not used or were inaccessible

NTSB Lessons and Recommendations

- For Trucking Companies
  - Develop a fatigue management program to educate employees on the risks and countermeasures of driver fatigue
  - Install driver monitoring systems across the entire fleet and integrate the data into safety policies and training programs
- For Bus Companies
  - Ensure regular inspection and accessibility of passenger seatbelts
  - Mandate seatbelt use on all trips and provide safety briefings before each departure to reinforce compliance

4. Rear-End Collision between Combination Vehicle and Medium-Size Bus

Facts

- At 1:36 a.m. Dec. 16 2022, a truck-tractor with a semitrailer crashed into the rear of a slower-moving bus on Interstate 64 near Williamsburg, Virginia
- The truck, traveling between 65 and 70 mph with cruise control, did not brake before impact, while the bus was moving at 20 to 25 mph
- The collision resulted in the deaths of three bus occupants, serious injuries to nine bus occupants and the truck driver, and minor injuries to 11 bus occupants

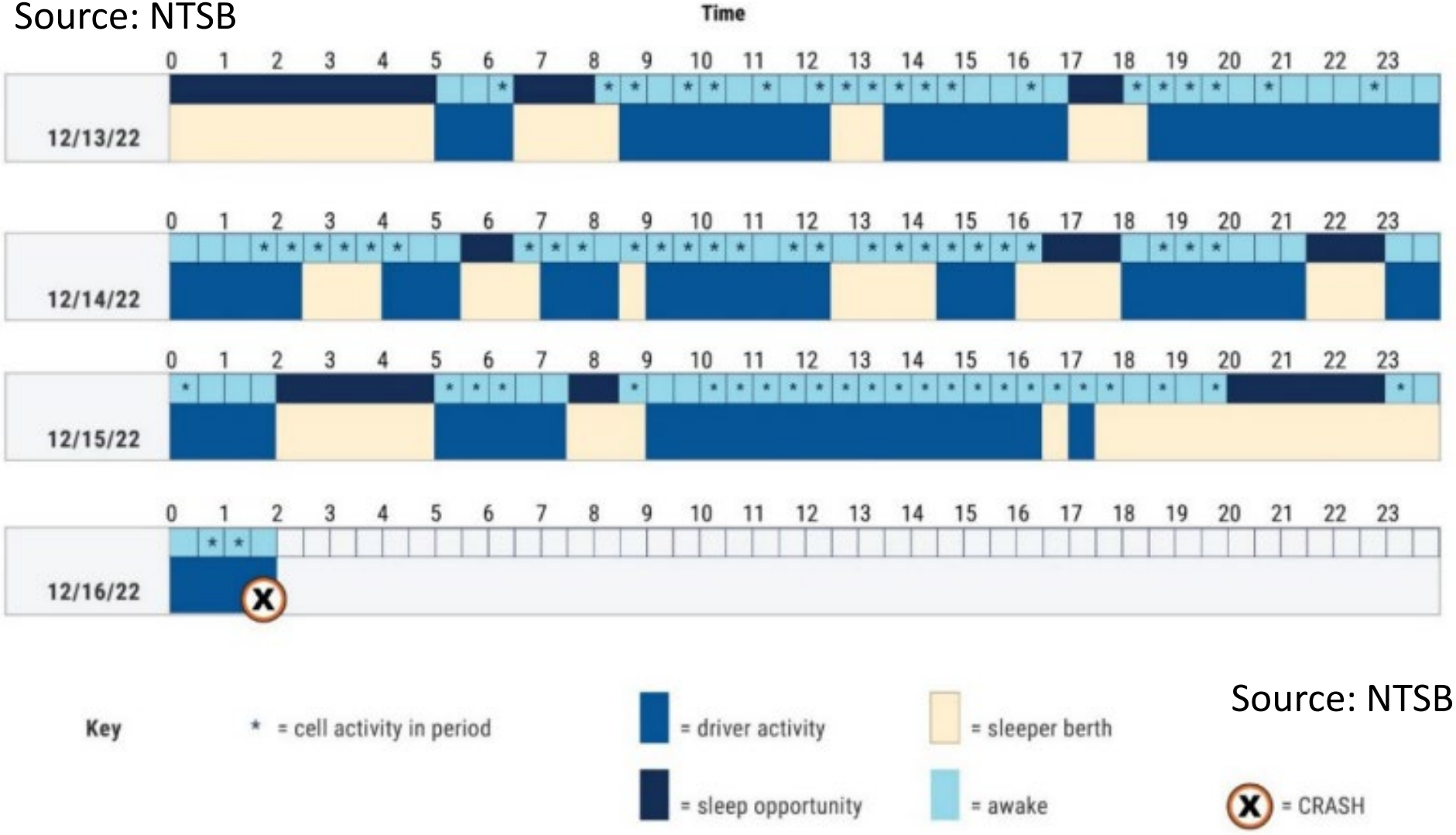
Source: NTSB

https://www.ntsb.gov/investigations/Pages/HWY23MH004.aspx

Source: NTSB

Schedule

Source: NTSB



Source: NTSB

NTSB Probable Cause

- Driver's fatigue, due to excessive driving time and limited sleep opportunity, which resulted in his lack of response to the slow-moving bus ahead
- Contributing to the truck driver's fatigue was the motor carrier creation of fictitious driver accounts in the electronic logging device system that enabled drivers to operate their vehicles for hours in excess of federal regulations
- No medical conditions

Safety Issues

- The driver was fatigued due to excessive driving time and limited opportunity for sleep, which prevented a timely reaction
- The freight company created falsified driving records, lacked a fatigue management program, and removed truck crash avoidance systems, such as automatic emergency braking
- The passenger carrier had poor safety practices, including improper vehicle registration, a driver without a proper license, and poor maintenance
- The bus was moving slowly due to a possible fuel filter issue, and its low speed on a high-speed roadway increased the severity of the impact
- Electronic logging with data tracking and in-cab video can improve safety

NTSB Lessons and Recommendations

- Recommendations for Motor Carriers
  - Establish a process to verify the accuracy of driver records to ensure compliance and proper oversight
  - Implement a fatigue management program to educate all personnel on the risks and countermeasures associated with driver fatigue
  - Utilize information from onboard video recorders to enhance driver training and safety performance

5. Multivehicle Collision Involving a Milk Tank Combination Vehicle and Stopped Traffic Queue

Facts

- At 10:07 p.m. June 9 2021, a truck-tractor with a tank trailer crashed into a queue of stopped passenger vehicles on SR-202 in Phoenix, Arizona
- Traveling at 62-64 mph without slowing or steering, the truck initiated a chain-reaction collision involving six other vehicles
- The crash resulted in four fatalities and 11 injuries among passenger vehicle occupants, with the truck-tractor and one car consumed by fire

Source: NTSB

https://www.ntsb.gov/investigations/Pages/HWY21MH008.aspx


1 mile
LAW ENFORCEMENT
AT PRIEST
EXPECT TO STOP
Dynamic Message Sign
10
202
Crash location
143
Priest Drive
Dynamic Message Sign
10
202

Source: NTSB

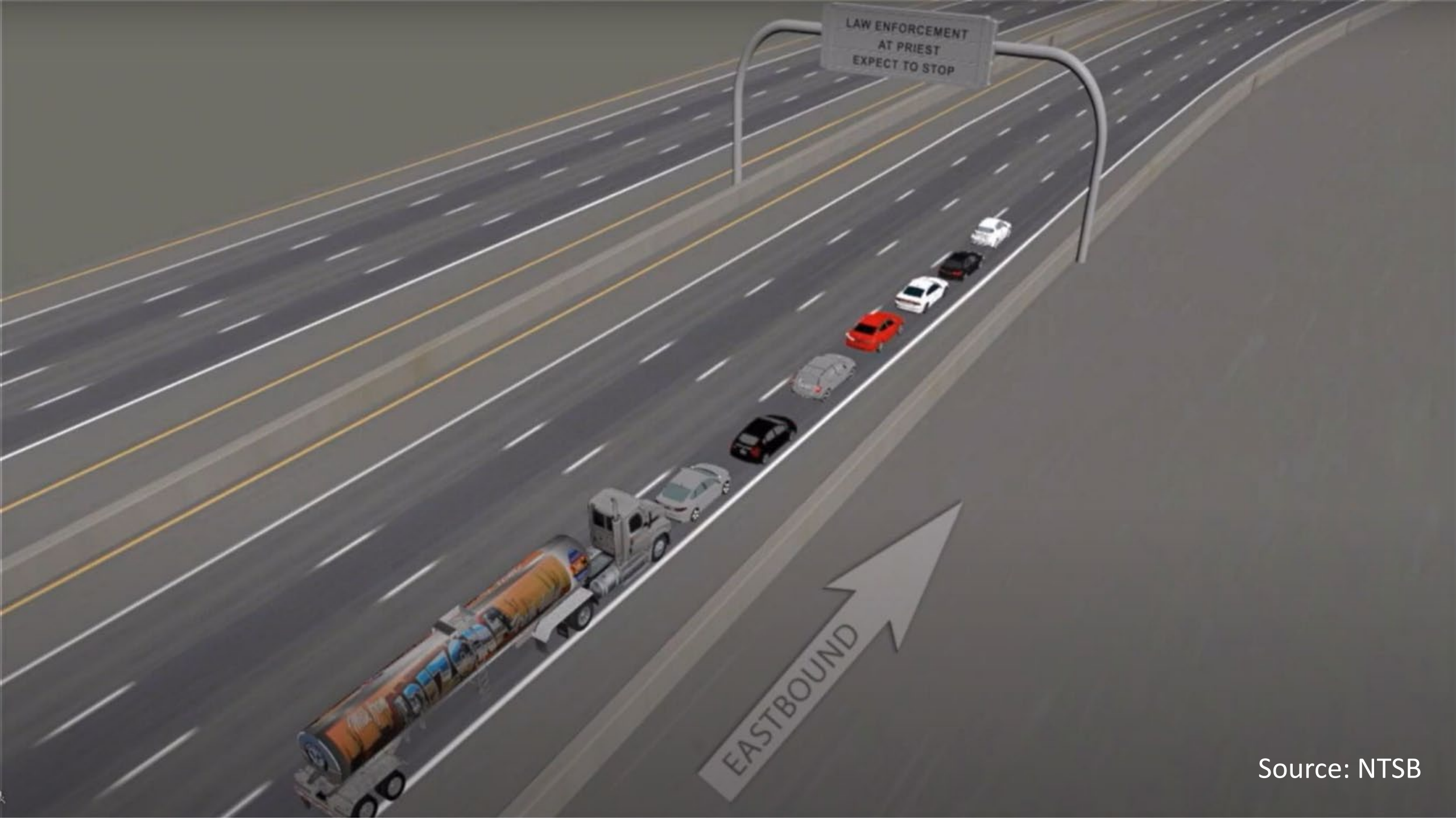
Source: NTSB


Source: NTSB

Source: NTSB


Source: NTSB

Source: NTSB



Source: NTSB


Chevrolet
Tank trailer
Truck tractor
Nissan
Lexus
Mercedes
Dodge
EASTBOUND
Toyota
Ford
Fatally injured: 4 persons
Hospitalized: 11 persons

Source: NTSB

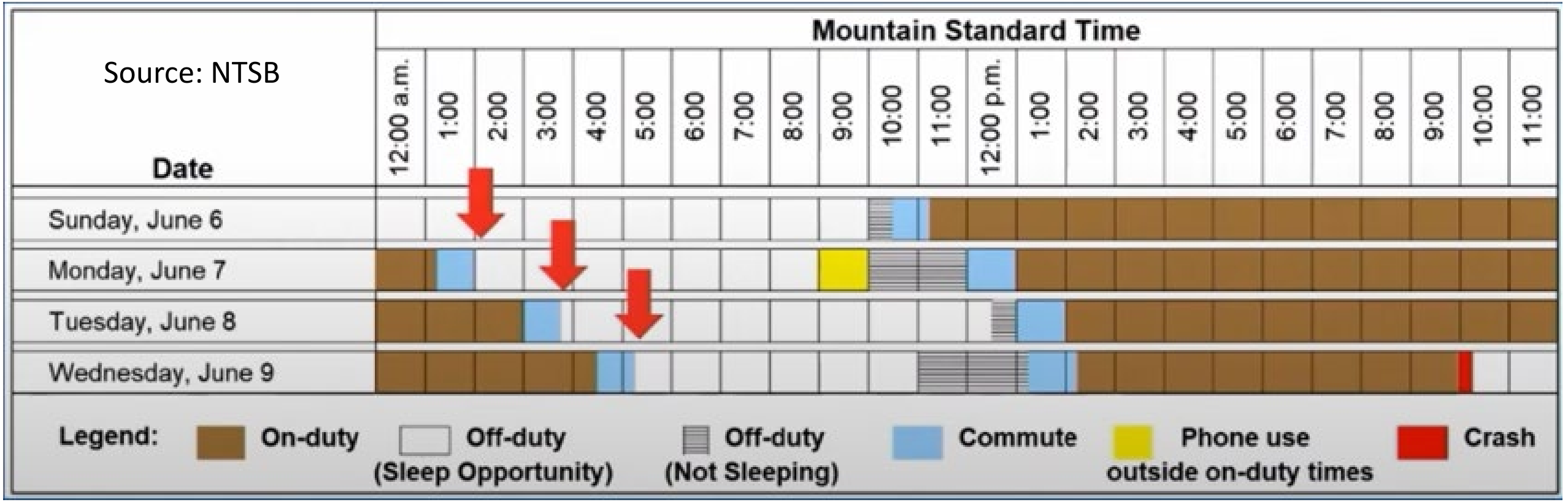

Toyota
Mercedes
Ford
Right shoulder barrier


Chevrolet
Truck-tractor

Source: NTSB

Schedule

Source: NTSB



NTSB Probable Cause

- Driver's failure to respond to the fully conspicuous traffic queue, likely as the result of fatigue
- Contributing to the crash was the motor carrier's
  - Poor oversight of its drivers
  - Lack of fatigue management program
  - Failure to enforce its own policies, such as those regarding on-duty hours
  - All a consequence of its inadequate safety culture
- No medical conditions

Safety Issues

- The truck driver was likely fatigued, which prevented a reaction to stopped traffic
- The company ineffectively implemented a monitoring system and lacked a fatigue management program, allowing drivers to exceed hours-of-service
- Drivers operating under this exemption are at a higher risk of fatigued driving due to a lack of oversight
- The lack of systems such as automatic emergency braking and vehicle-to-everything (V2X) communication prevented the truck from avoiding the crash
- The use of three-point seat belts and proper child restraint systems would have reduced serious injuries and the possibility of occupant ejection from the passenger vehicle

NTSB Lessons and Recommendations

- Implement a more effective training program using monitoring system data to reduce safety violations
- Establish a process to verify the accuracy of driver work hours and ensure compliance with company policies
- Develop and implement a driver fatigue management program

6. Multivehicle Crash in a Queue of Slowed and Stopped Traffic

Facts

- At 6:45 a.m. June 12 2020, a truck-tractor with a semitrailer struck the end of a slowed and stopped traffic queue on Interstate 39 near Arlington, Wisconsin, which had formed due to prior collisions
- This initiated an eight-vehicle crash that resulted in four fatalities and three serious injuries

Source: NTSB

https://www.ntsb.gov/investigations/Pages/HWY20FH006.aspx


Peterbilt truck-tractor
Mack truck
Freightliner truck-tractor
VW sedan
Kia SUV
Source: NTSB

Schedule

- During the week of the crash, driver's workday began between 1:30 a.m. and 4:00 a.m.
- Workday ended in the late afternoon, about 4:00 p.m. to 4:30 p.m.
- On the Thursday evening before the crash, the driver went to bed at his residence about 8:00 p.m. and woke up about 2:15 a.m.
- The driver's sleep location alternated during the work week, with two nights (Monday, June 8, and Wednesday, June 10) of rest occurring out of state in the truck's sleeper berth
- Because the driver did not survive the crash, limited information was available regarding his activities, sleep opportunity and quality of sleep on the two nights spent in the sleeper berth

NTSB Probable Cause (1 of 2)

- Driver's failure to respond to slow-moving traffic due to fatigue
- Insufficient evidence on medical conditions
  - Cardiac disease
  - Diabetes
  - Gabapentin medication
- According to his wife, the driver had been experiencing ongoing fatigue for which he was scheduled to be evaluated by his doctor the day after the crash

NTSB Probable Cause (2 of 2)

- Contributing to fatigue was his undiagnosed obstructive sleep apnea
  - High BMI (48 kg/m2). The truck driver's BMI corresponds to severe obesity, which alone placed him at high risk of significant OSA
  - Large neck circumference. This factor is even more strongly associated with OSA risk than BMI
  - Men are two to three times more likely to have OSA than nonpostmenopausal women
  - The truck driver was 55 years old. OSA risk in adults increases with age until about the sixth or seventh decade of life
  - The truck driver had high blood pressure and diabetes. OSA is more prevalent among people with those conditions
  - The truck driver smoked which increases OSA risk

NTSB Lessons and Recommendations

- Obstructive sleep apnea can cause driver fatigue and increase the risk of crashes
- The NTSB has recommended that federal authorities identify drivers at high risk of OSA
- To obtain their unrestricted medical certification, these drivers should be properly evaluated and treated

What Carriers Can Do to Prevent Fatigue-Related Crashes?

Fatigue Management Program (FMP)

- Safety Culture
  1) Education
  2) Training
  3) Continuous communications – Including partnerships
- Fatigue Risk Management System
  1) Operations
  2) Identify risks with processes and controls
     - Predictive, proactive, reactive
     - Sound scheduling & routing, sleep disorders program, fatigue detection technologies
  3) Risk assessment
  4) Measures and countermeasures
  5) Evaluation

Shared Responsibility

- Reducing fatigue in driver schedules is a shared responsibility between management and drivers
  - Management, including planning and dispatch, establishes a driver's work demands and ultimately determines available sleep opportunities through the driving schedule
  - Drivers are responsible for utilizing their available rest time effectively and communicating any fatigue concerns
- An effective fatigue management program requires continuous collaboration to ensure safe and sustainable work practices

Promoting a Safety Culture

- Cultivate a workplace that encourages drivers to value sufficient sleep and actively manage their fatigue for safety
- Drivers must be trained to recognize objective signs of fatigue as a significant physiological risk
- A true safety culture exists when drivers feel comfortable and empowered to communicate when they are tired without fear of repercussions
- If drivers are unwilling to report fatigue, the safety culture is compromised

Effectiveness of FRMS

How Effective are Fatigue Risk Management Systems (FRMS)? A Review

The primary enablers of, and barriers to, the implementation of FRMS are a set of intra-organizational cultural requisites

One key requisite is the establishment of a shared responsibility framework, without which effective FRMS implementation is not possible

If workers feel they cannot report fatigue, or fatigue-related errors/incidents without punitive actions or stigma, implementation of FRMS are unlikely to yield positive results

Schedule Predictability

- Adopt practices that provide drivers with advance information about their schedules
- This allows drivers to effectively plan their work and rest schedules
- Reliable advance information on scheduled appointments is crucial for drivers to plan effective sleep and nap opportunities

Fatigue-Conscious Resource Allocation

- Leverage resources to provide drivers with night-time opportunities to sleep
- Consider travel time to employment location
- Schedule appointments that favor opportunities for naps
- Favor sequences of duty periods that maximize time to recover from sleep debt during restart
- Schedule drivers in line with their natural time of day preferences and promote regularity of schedules or advanced notice to aid driver planning
- Query about fatigue levels when revising assignments

Management Support

- Encouraging sufficient rest stops during long-haul driving
- Promoting the use of naps to supplement sleep, understanding that any sleep is beneficial, even if night-time sleep is ideal
- Longer naps can lead to deep sleep, but drivers should allow time for recovery from sleep inertia, using strategies like light and noise exposure, physical activity, and smart caffeine use
- Emphasizing the importance of keeping sleep times as stable as possible
- Suggesting considering a nap prior to an evening departure

Driver's Personal Fatigue Management

- Drivers are responsible for obtaining adequate sleep on workdays and during recovery periods to manage fatigue
  - They should follow principles of sleep hygiene and seek treatment for sleep disorders
- While not a substitute for adequate sleep, strategies like breaks, exercise, smart caffeine use, and social interaction can provide short-lived relief from fatigue
  - Drivers should be aware these are temporary measures and not a replacement for proper rest

NAFMP

North American Fatigue Management Program

nafmp.org

New NAFMP Website

- Tools
  - FMP Template
  - Implementation Manual
  - ROI Calculator
- Courses
  - eLearning Platform
  - PowerPoints with and without audio
  - For carrier's executives, safety managers, dispatchers, instructors, drivers, driver's families, shippers & receivers
- Webinars, Info Sessions & Articles
  - Gallery
  - List
  - Categories
  - Sing up for article nitrifications
- Podcast
  - The NAFMP Pod
  - Available from eight platforms
- Events
  - Download individual event
  - Subscribe to Calendar of future events

NAFMP Proficiency Credential

- Formal recognition that a driver has mastered the knowledge and skills of the NAFMP
- Drivers must complete the Driver NAFMP Validated Learning and Assessment Program (VLAP) that will be available in the NAFMP eLearning Platform in the first quarter of 2026
- The Credential will be valid for three years

Driver Training Program Development

- September 16 CVSA Webinar
- By CVSA Director of Compliance Programs Katie Morton
- Available now at CVSA Learning
  - *Motor carriers often seek additional resources to maintain driver training compliance. This webinar reviewed the key essentials to incorporate into an in-house training program to ensure drivers are fully knowledgeable of their scope of responsibilities*

Questions

Connect with me to coordinate a free fatigue management session for your organization

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