WRONG WAY DRIVING DETECTION SYSTEM (WWDDS) REPORT

CONNECTICUT DEPARTMENT OF TRANSPORATION

PURSUANT TO PUBLIC ACT NO. 23-51

Date Issued:

Contents

EXECUTIVE SUMMARY

The Senate and House of Representatives in General Assembly enacted "An Act Concerning Wrong-Way Driving Detection and Prevention" under Public Act No. 23-51. The Public Act became effective on October 1, 2023 and included the following:

> The installation of wrong way driving detection and notification systems on at least 120 highway exit ramps that the department determines are at high risk for motor vehicle operators driving in the wrong direction. The system shall be capable of:
>
> i. Alerting a motor vehicle operator with the use of flashing lights when such operator is driving in the wrong direction.
> ii. Notifying a law enforcement unit when a wrong-way operator is detected.
> iii. Pilot a system to broadcast the presence of a wrong-way operator on electronic message boards along the highway.

The Public Act was initiated in response to crash data trends. This report includes a summary of wrong way driving crash data between January 1, 2021 through October 31, 2024. The overall crash data trends indicate that most wrong way driving crashes occur in dark conditions, at two-way divided ramps, and most commonly include drivers under the age of 36. Additional review indicates that nearly all wrong way driving crashes that resulted in at least one fatality included a driver operating a vehicle under the influence of alcohol, drugs, or medication.

To aid in the reduction of wrong way driving incidences in the State, available countermeasures were cross referenced with statewide crash data trends to effectively incorporate a variety of static and technology-based improvements.

Earned and owned media efforts on the Connecticut Department of Transportation's (CTDOT) social channels and through the press continue to be a priority. Statewide press coverage of this issue is consistent and helps further the CTDOT's message.

To help reduce the overall wrong way driving incidences throughout the state, CTDOT has:

- **Installed over 120 WWDDS. ***
- **Piloted a broadcasting system. ***
- Begun implementing countermeasures as part of individual projects and incorporating them into larger projects. Countermeasures include:
    - Traffic Signal Relamping
    - Wrong Way Static Signing
    - Wrong Way Pavement Markings on off-ramps
    - Wrong Way Pavement Markings on secondary roads at off-ramps
    - Wrong Way Delineators
- Initiated the "One Wrong Move" educational campaign.

***Primary focus of this report**

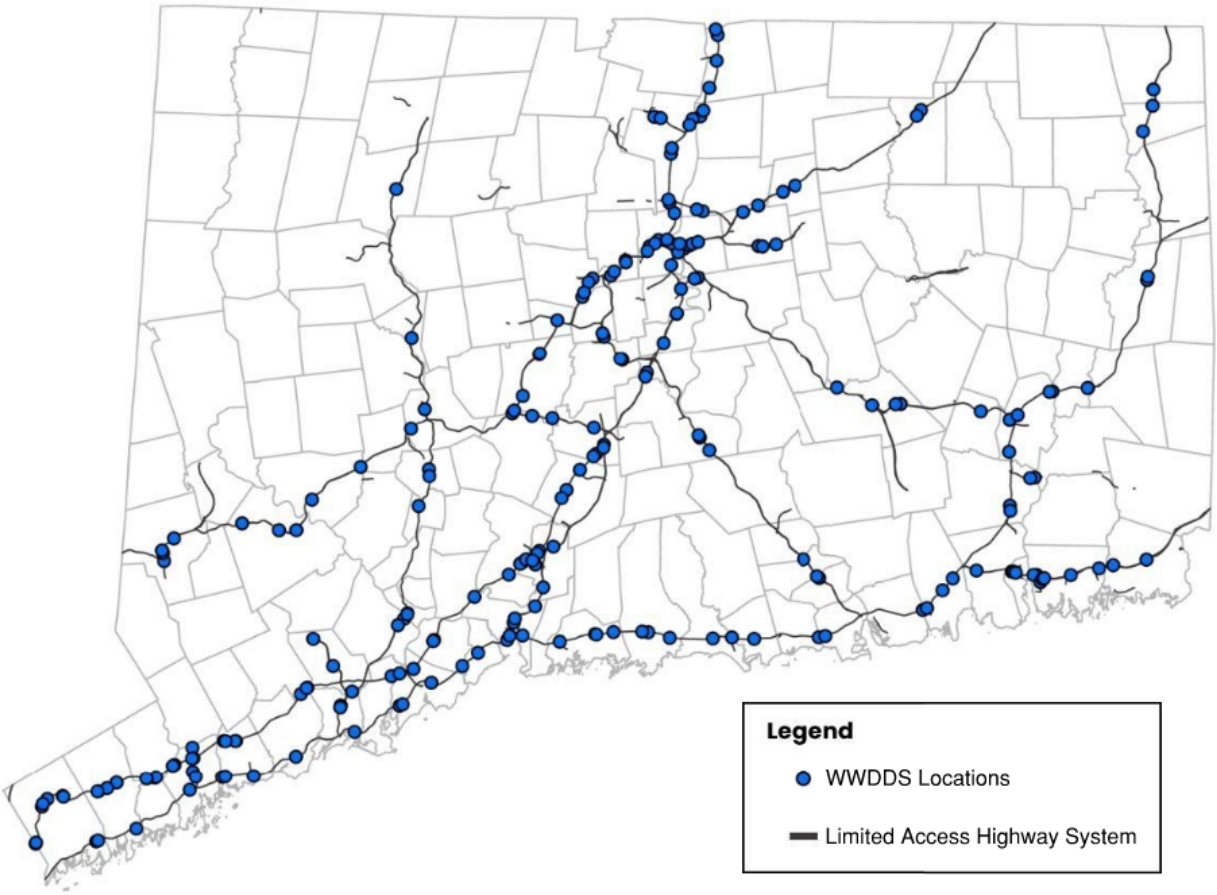
This report recommends:

A. Expanding the WWDDS to incorporate as many ramps as feasible.
B. Not pursuing a notification system that broadcasts alerts about a wrong-way driver's presence on electronic highway variable message signs (VMS) based on the findings of the pilot program.
C. Evaluating other methods of targeted location notification about a wrong-way driver's presence other than the use of electronic highway variable message signs (VMS).

BACKGROUND INFORMATION

ROADWAY NETWORK

The CTDOT has over 600 miles of state-maintained Limited Access Highway (highway) with over 700 off ramps connecting to secondary roads.



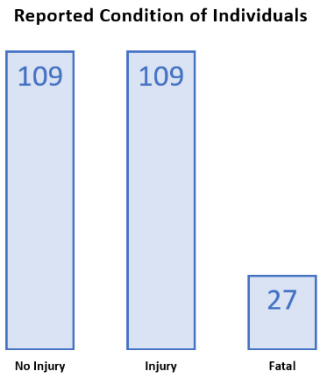
Each off ramp presents a risk for a motorist to enter a highway traveling in the wrong direction.

CRASH DATA ANALYSIS

A review of crash data (Table 1) was conducted for wrong way driving crashes on highways between January 1, 2021 and October 31, 2024.

The crash data analysis showed a total of 90 wrong way driving crashes within the study period. The 90 total wrong way driving crashes included 245 individuals. Of the reported conditions:

- 109 individuals had no apparent injury.
- 109 individuals had an injury.
- 27 individuals incurred a fatal injury.



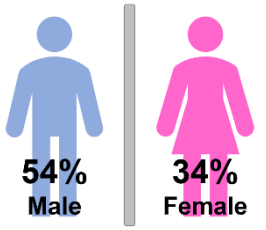
A breakdown of crashes is summarized in the following table:

Year	Crash Total	Fatality Total	No. of Individuals Involved
2021	27	4	80
2022	44	23	131
2023	16	7	45
2024*	6	13	16
Total	93	47	272

Table 1: Wrong way driving crashes from January 1, 2021 to October 31, 2024*

Wrong way driving crash statistics:

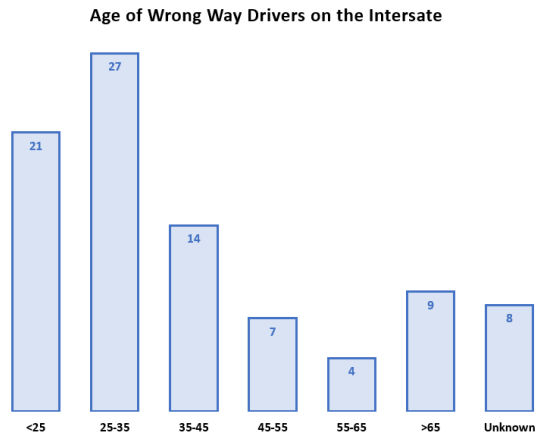
- 53% involved a driver under the age of 36 years old.



Gender of Wrong Way Drivers

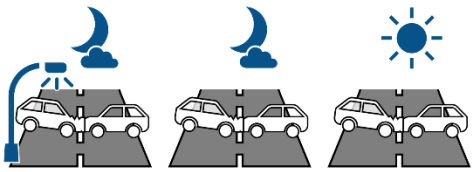
**12 % gender not reported*

Upon disaggregation of age data, approximately half (48) of the crashes included a driver under the age of 36 years old. As such, media campaigns have been targeting those in the younger generation while still being applicable to all age levels. Strategic placement of advertisements at gas stations, billboards, and on news stations allow for



widespread recognition while additional placement at restaurants frequented by a younger generation aid in conveying the wrong way driving message to all drivers. The wrong way driving commercial was aired on the November 2, 2024 World Series baseball game in an effort to reach target audience.

- 76% occurred in dark conditions.



To mitigate wrong way driving crashes occurring in dark conditions, dusk to dawn lit wrong way signs are being installed as part of the WWDDS to grab the driver's attention and increase awareness. In addition to the dusk to dawn lit legend feature, the wrong way sign LED borders begin to flash when wrong way driving is detected. Static improvements including retroreflective strips, various delineators, and pavement marking arrows have also been initiated to combat the frequency of wrong way driving crashes in dark conditions.

WRONG WAY DRIVING DETECTION SYSTEM (WWDDS)

RAMP PRIORITIZATION

With an inventory of over 700 off ramps CTDOT needed a methodology to identify locations to be prioritized to be outfitted with WWDDS. Various ramp features were identified to be contributing factors to increase the chance of wrong way driving. Those features were assigned points and locations with higher points totals were denoted as higher priority. Priority was given to ramps with:

- On/Off Ramps located next to each other on the same side of the roadway – A review of the crash data indicated that this type of configuration was present on most wrong way driving incidents.
    - Ramps with this configuration were assigned additional points if there was a raised median or guiderail present – Research suggested that these features could obstruct visibility of entrance

ramp for left turning vehicles, potentially causing them to turn into the off ramp instead.

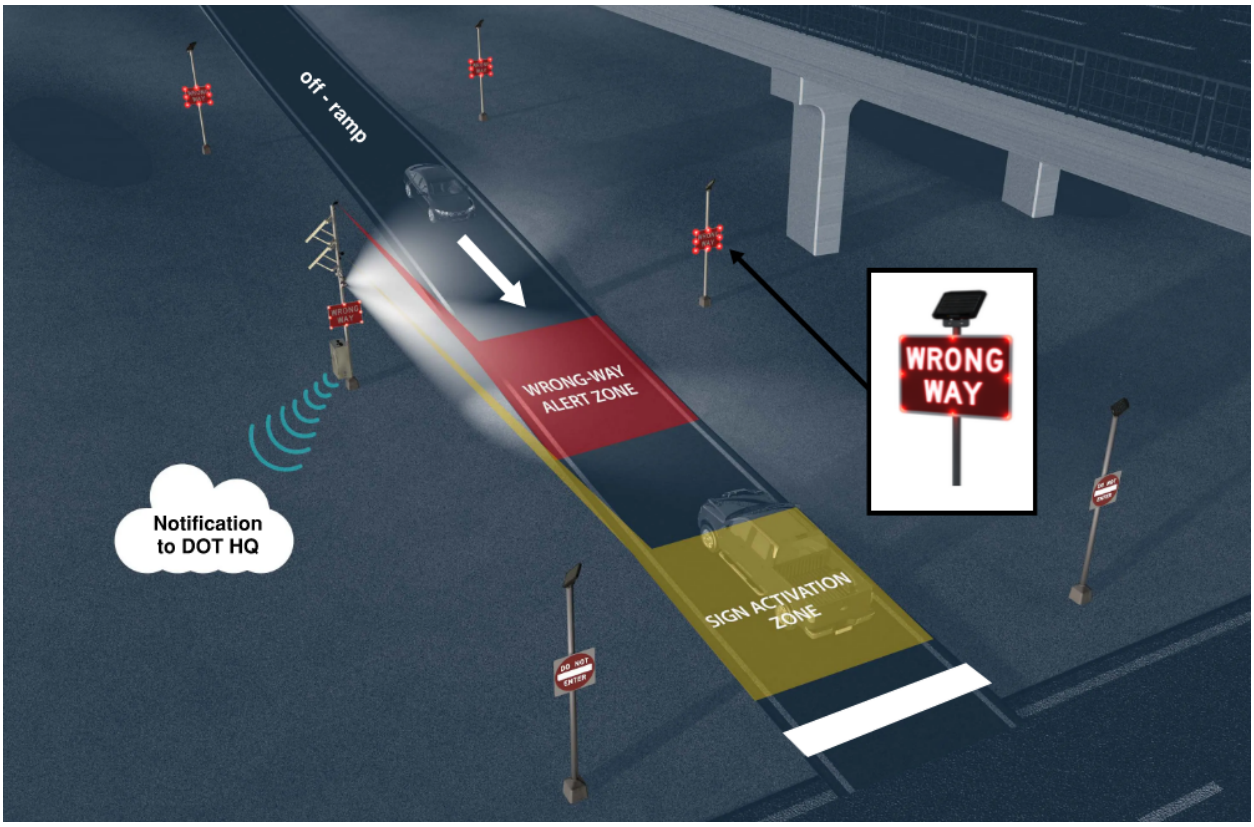
- A liquor establishment within ½ mile in its proximity - A review of the crash data showed that nearly all the wrong way driving crashes that resulted in fatalities involved an operator that was under the influence.
- No illumination present.
- Reported wrong way driving event or crash.

The result of the prioritization was the identification of locations that were deemed higher risk and are currently in varying stages of implementation.

HOW IT WORKS

The Wrong Way Driving Detection Systems (WWDDS) use advanced technology to detect and verify wrong-way vehicles traveling past a system located along an off-ramp. When in resting mode, the signage along an off-ramp appears to be the traditional "DO NOT ENTER" and "WRONG WAY" sign with the exception that the first "DO NOT ENTER" sign is internally illuminated for improved visibility from dusk to dawn. When the system detects a vehicle traveling the wrong way along an off-ramp, the LED border of the "WRONG WAY" signs located along that ramp begin to flash red and the system communicates the wrong way driving maneuver through an application. Alert messages are immediately transmitted to both the CTDOT Highway Operations Center, and the Connecticut State Police Barracks assigned to the location, where live video footage is assessed, and appropriate measures are taken.

In addition to deploying Wrong-Way Detection and Notification Systems, the CTDOT piloted a process to provide wrong-way notifications for motorists on a variable message sign. Details of this pilot deployment are provided in subsequent sections and in Appendix C.



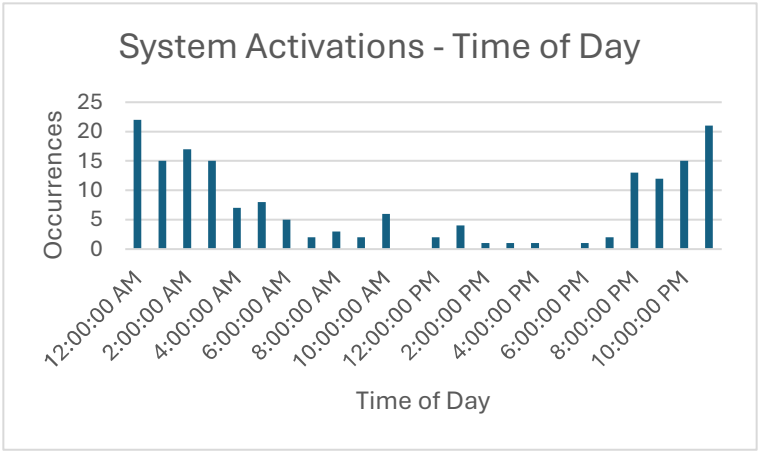
CURRENT DEPLOYMENT LOCATIONS

Since August of 2023, over 120 activated Wrong Way Driving Detection Systems have been installed and activated across the state of Connecticut (Figure 1). These installations have been completed using a combination of state and contracted forces to deploy these systems expeditiously. As shown in Figure 2, there are approximately 39 systems installed in the central Connecticut area, followed by approximately 25 systems in the eastern region, approximately 34 systems in the southwestern region, and approximately 23 systems in the northwestern region.

SYSTEM PERFORMANCE

The approximately 120 WWDDS prompt approximately ***30 alerts per month*** from vehicles traveling the wrong way on an off ramp. Of those, approximately **80 percent of the wrong way drivers have self-corrected after the warning system was activated**.

Data received from the activated WWDDS show that approximately 80 percent of wrong way activations occur in the overnight hours, and the most prevalent days of the week are Friday, Saturday, and Sunday accounting for nearly 60 percent of all activations. The data collected from the WWDDS provide CTDOT staff with information to identify locations with repeat confirmed wrong way driving incidents and conduct field reconnaissance to determine if additional countermeasures are appropriate. Additionally, any repetitive patterns that are noticed from the WWDDS are communicated to State and Local Law Enforcement which results in increased patrolling of these specific locations and specific time of day.



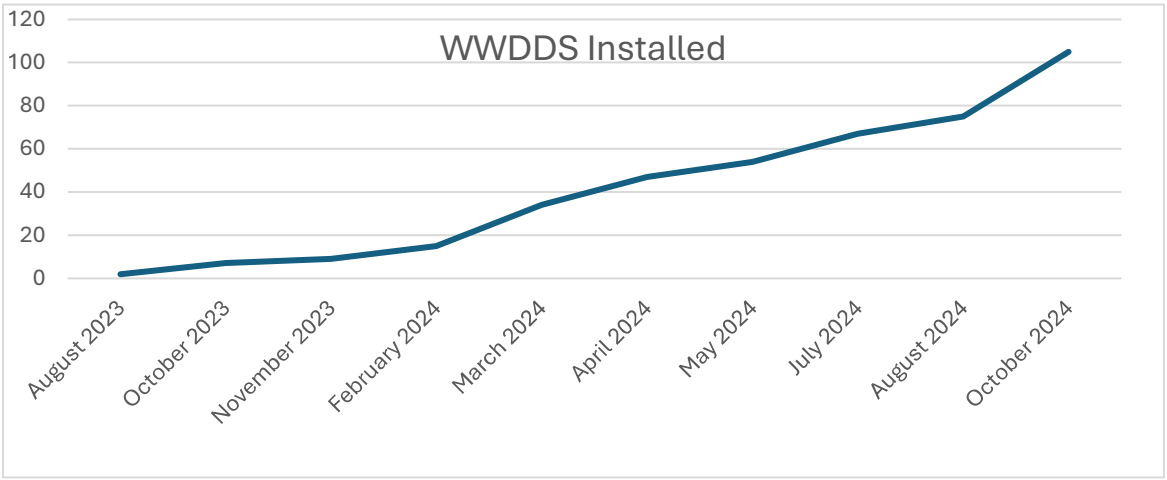


Figure 1: WWDDS Installed since August 2023

VARIABLE MESSAGE SIGN NOTIFICATION PILOT

In conjunction with the Wrong Way Driving Detection System (WWDDS), CTDOT piloted a variable message sign (VMS) study on Interstate 691 between Southington and Meriden. The VMS is located 5.2 miles in advance of a WWDDS with full highway video coverage for CTDOT staff to monitor. At a minimum 3 minutes are required from the point of WWDDS activation at the off-ramp to the time when the VMS displays the message "WRONG WAY DRIVER POSSIBLE, USE CAUTION". The sign would be deactivated after 10 minutes unless the threat diminished (self-correction, police interception, etc.). On September 16, 2024, the VMS message was deployed in response to a detection by the WWDDS at the test site. The message remained on the VMS for 10 minutes before it was deactivated. This method was not deemed favorable based on the narrow window where the wrong way driver would pass the VMS and therefore the message would no longer be applicable, and the gap where the right-way drivers would not be informed of the wrong way driver. This gap is due to the time it takes to verify the event, technological constraints with posting a message to a VMS in a timely manner, and giving the drivers traveling in the correct direction enough decision time before encountering the wrong way driver. Therefore, it is not recommended to pursue VMS based notifications.

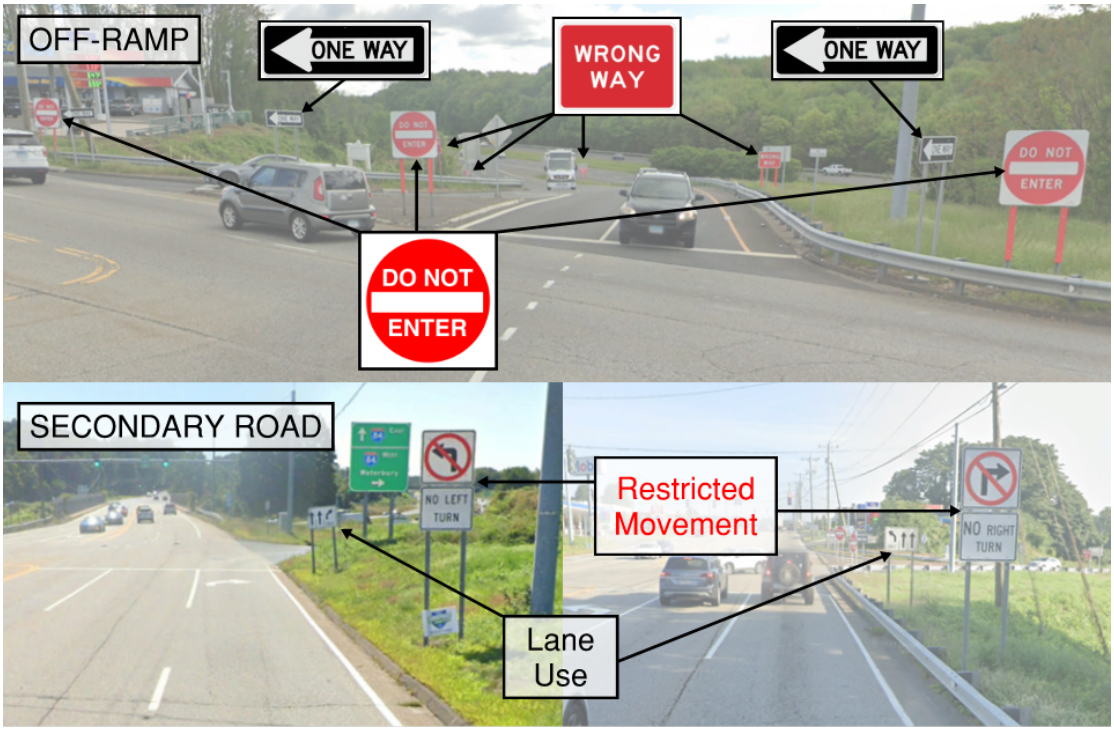
ADDITIONAL COUNTERMEASURES IMPLEMENTED

CTDOT has begun implementing wrong way driving countermeasures through individual projects in addition to incorporating these countermeasures into existing on-going projects. Countermeasures include:

TRAFFIC SIGNAL RELAMPING

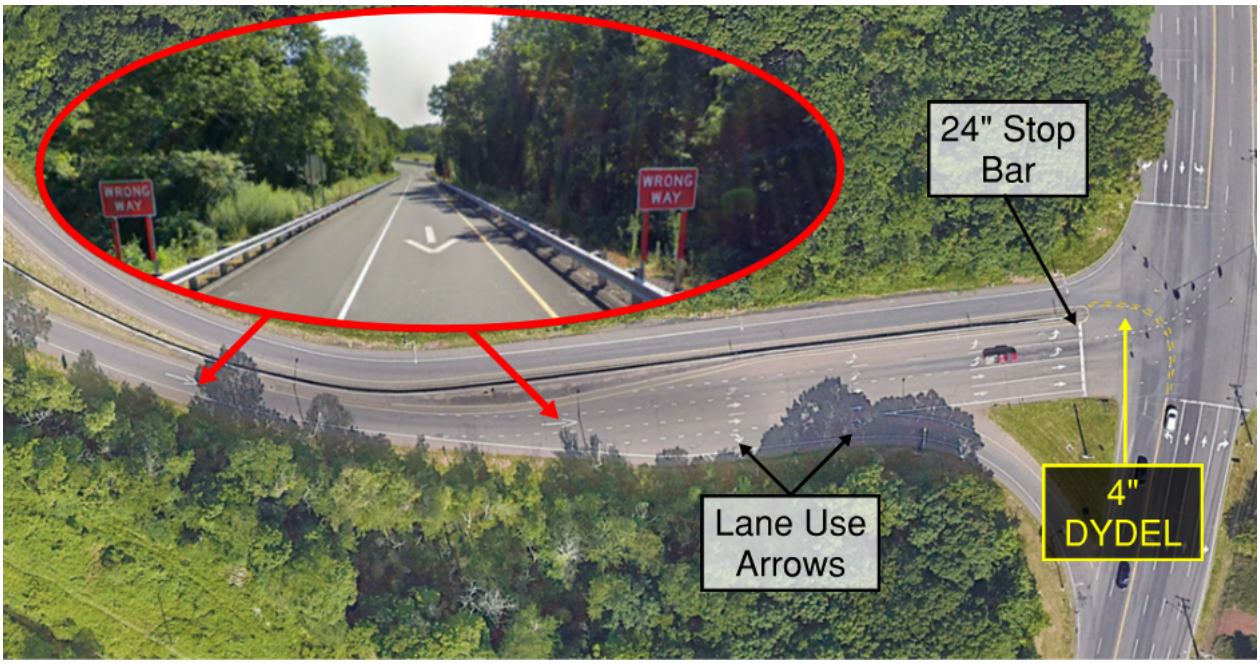
Signal lens vertical green arrows have been installed at traffic signals at 119 intersection roads with off ramps within Districts 1 and 2. Districts 3 and 4 projects are currently in construction.

WRONG WAY STATIC SIGNING

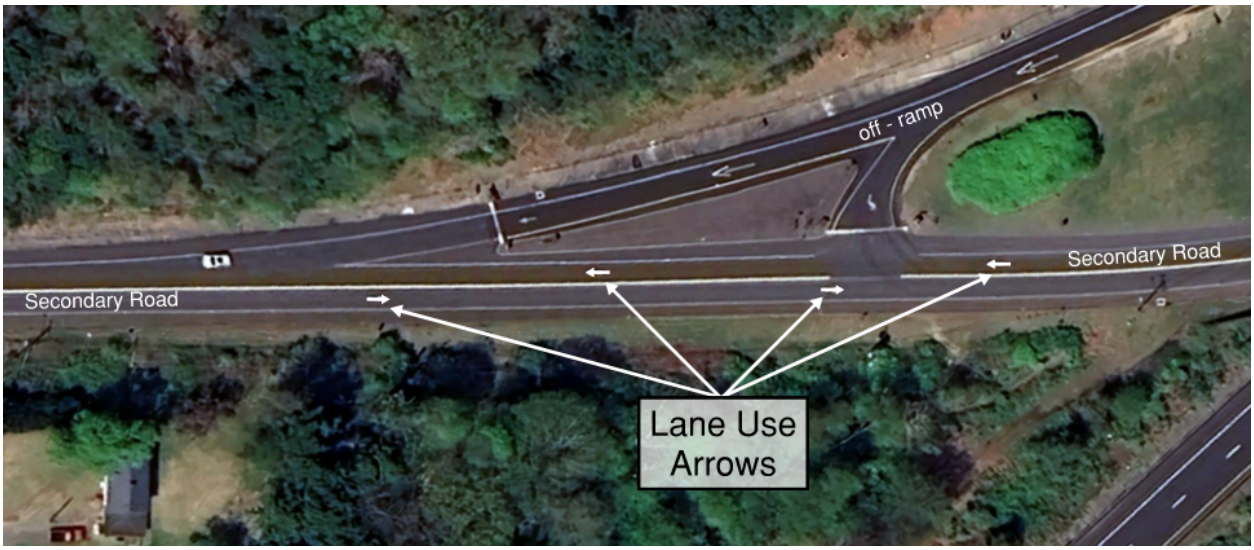


WRONG WAY PAVEMENT MARKING ON OFF-RAMPS

Wrong way pavement arrows have been installed at 445 off ramps throughout the state spanning across all four districts.



WRONG WAY PAVEMENT MARKINGS ON SECONDARY ROADS AT OFF-RAMPS



WRONG WAY DELINEATORS

CTDOT Maintenance is installing the delineator reflectors on all active guiderail projects. A recessed pavement marker pilot is currently installed at four off ramp locations on Interstate 84 in Southington and is being tested for longevity. Additionally, intricately designed guide rail waffle style reflectors are being tested for longevity at exit 32 on Interstate 84.

"ONE WRONG MOVE" EDUCATIONAL CAMPAIGN

In FY24, the CTDOT continued its "One Wrong Move" campaign. The campaign's message is clear: "One decision can change everything - and is almost always fatal." CTDOT has developed a comprehensive paid media campaign that includes a TV spot (in English and Spanish), streaming tv, billboards, radio, gas station radio, in-bar advertising, gaming advertising, digital display and paid social media. In addition, a webpage was developed to support the campaign.

CTDOT has identified five target areas across the state in Naugatuck, Waterbury and Lisbon that have seen a spike in wrong way driving on exit ramps based on data collected from the implemented WWDDS. Paid streaming radio (such as Spotify, for example) is being used to geo-target to these 'hot spots' areas, to catch drivers in the moment when in proximity to

identified exit ramps. Bars and billboards in those immediate areas will also have an increased presence of our wrong way driving message.

LOOKING FORWARD

CTDOT has begun planning the next series of WWDDS which will include an additional 208 locations and will continue its "One Wrong Move" campaign. Additionally, implementation of wrong way driving countermeasures are currently underway.

REFERENCES

1. Wrong Way Driving Road Safety Audit (FWHA) - https://highways.dot.gov/media/10301
2. Wrong Way Driving (WWD) Low-Cost Safety Improvements (FHWA) - https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-07/WWD%20National%20Workshop%20Presentation.pdf
3. Compendium of Wrong-Way-Driving Treatments and Countermeasures (FHWA) - https://highways.dot.gov/research/publications/safety/FHWA-HRT-23-035
4. Wrong-Way Driving Solutions Handbook (TRB)

   https://nap.nationalacademies.org/catalog/27199/wrong-way-driving-solutions-handbook

APPENDICES

A. VMS Summary

Appendix A

WWD-VMS Pilot Study

Selection Methodology

In order to select a pilot location for activating a wrong-way driver message on a Variable Message Sign (VMS), it is necessary to determine the earliest point a message be conveyed to motorists without the wrong-way driver already having passed that point. Ideally, this would occur right when the wrong-way driver enters the highway. However, the time it takes to verify a wrong-way driver and display a message to a VMS prevents this.

1) An alert has to get sent from the Wrong-Way Driving Detection System (WWDDS) to the operator. This is estimated to take around 15 seconds.
2) The operator has to then review the detection and confirmation snapshots of the event and determine if the alert is legitimate. If the snapshots are inconclusive, then they review the camera livestream and recorded video. This was determined to take approximately 75 seconds. However, this time has the potential to be higher depending on operator time availability, including how many other incidents are occurring and how many staff are present at the operations center.
3) The operator has to contact and communicate with the appropriate Connecticut State Police (CSP) troop.
4) The operator has to display a message to the VMS. This involves manual overriding a message out to the VMS. This can take up to 90 seconds to display the message.

As detailed, the time it takes for a wrong-way driver to be verified and for a VMS to be activated takes 3 minutes.

For this exercise, these were the assumptions made:

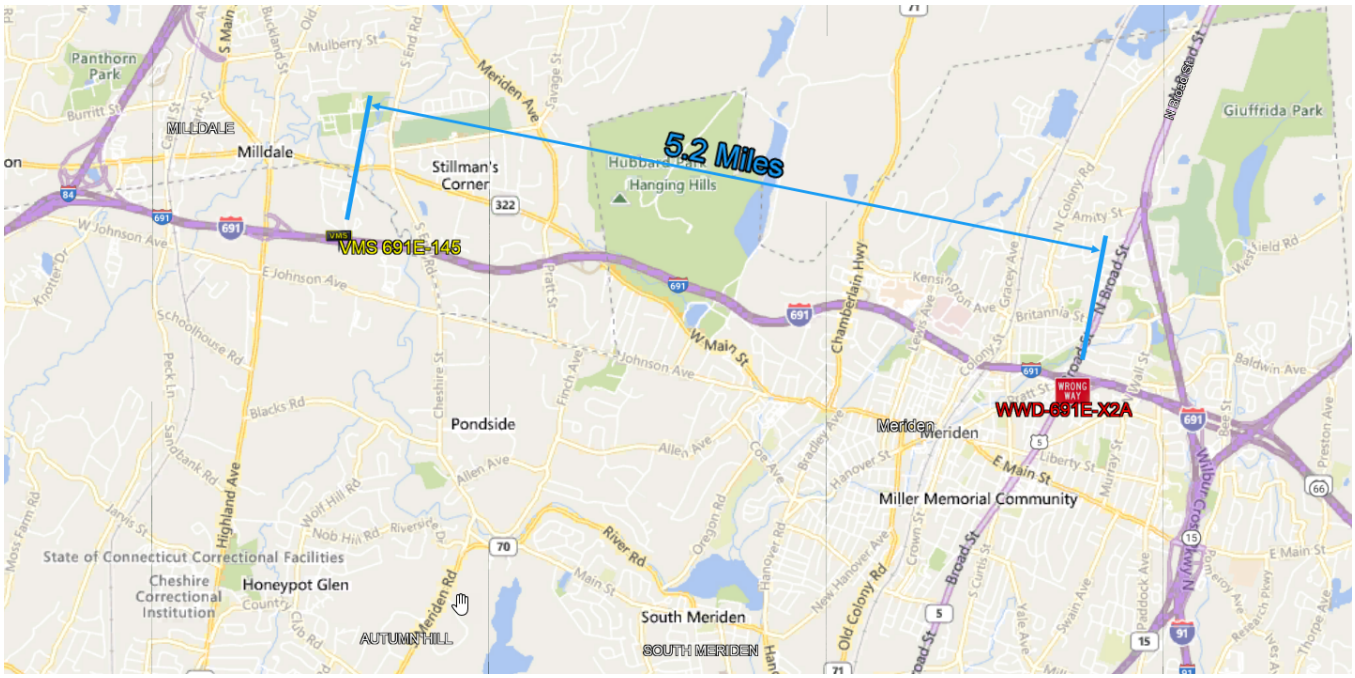
- Wrong-way driver is travelling at 65 mph.
- Right-way drivers are travelling at 65 mph.
- After 3 minutes, a wrong-way driver will have travelled 3.24 miles from entry at 65 mph.
- The distance between the VMS and the WWDDS should be more than 3.24 miles for drivers to have enough time to read the message on the VMS and process their next actions.
- Full highway camera coverage is preferred.
- There are no major highway interchanges between the pilot VMS and pilot WWDDS sites.

Selection

Using the assumptions outlined above, it was determined that the functional distance between a VMS and WWDDS should be around 5 miles. Therefore, the pilot VMS chosen was VMS-691E-145 (Mile Point 6.50 on I-691 EB) and the pilot WWDDS chosen was WWD-691E-X2A (Mile Point 1.30 on I-691 EB). This offers a 5.2-mile gap, closely matching our 5-mile target. Additionally, I-691 has full highway camera coverage. Lastly,

there are no major highway interchanges between VMS-691E-145 and WWD-691E-X2A. Additionally, I-691 had a combined AADT of 66,200 in 2018, with just 5,095 between the hours of 10:00 PM and 5:00 AM. Below is a map showing I-691 with the two chosen locations.

- Notified right-way drivers will have approximately 1 mile/minute of warning before encountering the wrong-way driver.
- There are 3.24 miles of unnotified right-way drivers encountering the wrong-way driver.
- An additional 2 miles of notification is recommended to allow the right-way drivers ample decision time before encountering the wrong-way driver.



VMS-691E-145 and WWD-691E-X2A along I-691

Standard Operating Procedure

The following Standard Operating Procedure was given to the operators in the Newington Operations Center (NOC) for piloting these locations as the first VMS-WWDDS test site.

1. Wrong-way driver alert is received at NOC and CSP.
2. NOC and CSP staff review snapshots and video recording to confirm the wrong-way driver did not self-correct on the ramp and may have entered the highway.
3. NOC and CSP staff monitor highway cameras to look for the wrong-way driver. The operator will then place a pre-developed message on the VMS saying "**WRONG WAY DRIVER POSSIBLE"** on the first frame, **"USE CAUTION"** on the second frame.
4. Staff continue to search for the wrong-way vehicle on highway cameras.

5. VMS sign is deactivated after 10 minutes unless it is determined that the wrong-way driver self-corrected, stopped travelling the wrong-way, or is intercepted by CSP.

Event

On September 16, 2024 at 9:24 PM, the first instance of a wrong-way driver occurred at the WWD-691E-X2A system after it was previously determined this location was to be a pilot site for the VMS-WWDDS test. An operator in the NOC reviewed the footage on BlinkLink and determined the wrong-way driver did not self-correct within view of the WWDDS cameras. Following the standard operating procedure, the operator attempted to find the wrong-way driver with the ATMS CCTV cameras, and then manually posted the designated message to VMS-691E-145. The operator was unable to locate the wrong-way driver on any of the ATMS CCTV cameras and no 911 calls came reporting of them either. Additionally, CSP was unable to locate a wrong-way driver either. After 10 minutes, the message was to be removed from VMS-691E-145.

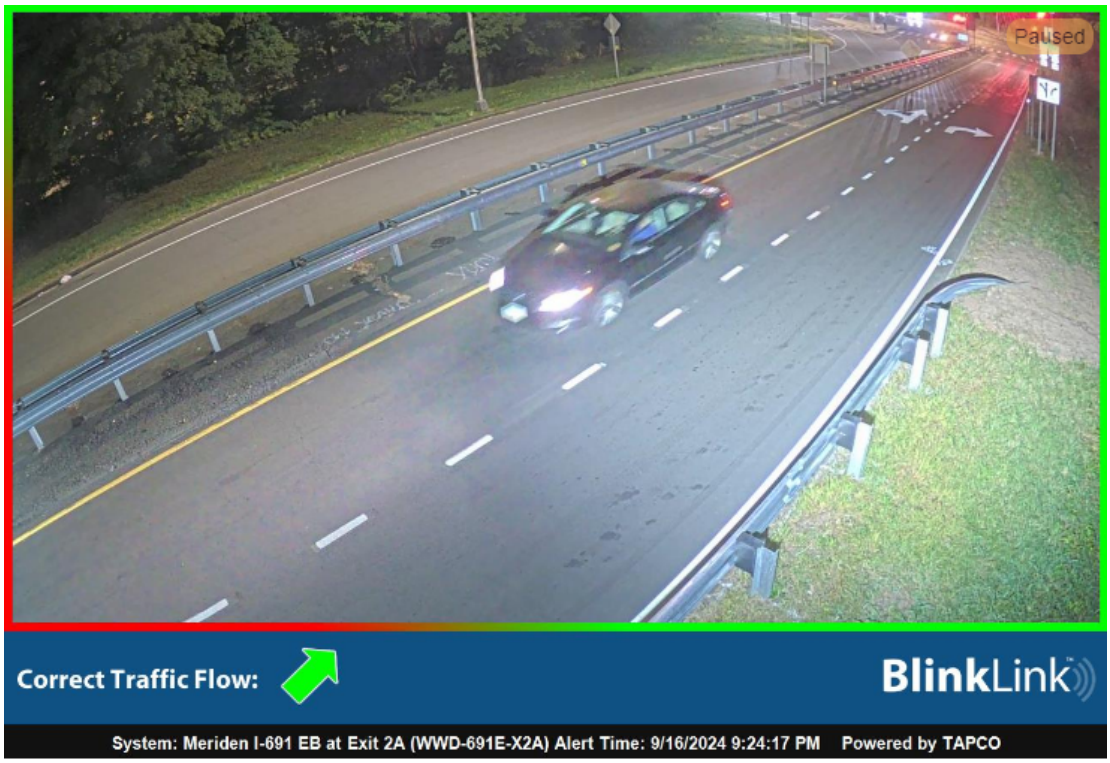
Additionally, while reviewing the recorded footage that BlinkLink provided from the event, it was determined that the wrong-way driver was seen travelling back down the ramp the correct direction about 40 seconds after they were seen going up the ramp the wrong-way, and then out of view. It was assumed that they self-corrected just out of view of the WWDDS cameras, and before an operator could check the ATMS CCTV cameras.

Two nights later, on September 18, 2024 also at 9:24 PM, another wrong-way driver was reported by BlinkLink at the WWD-691E-X2A system. In this case, the operator on shift was able to determine that the wrong-way driver self-corrected, so it was not necessary to post a message to the VMS.

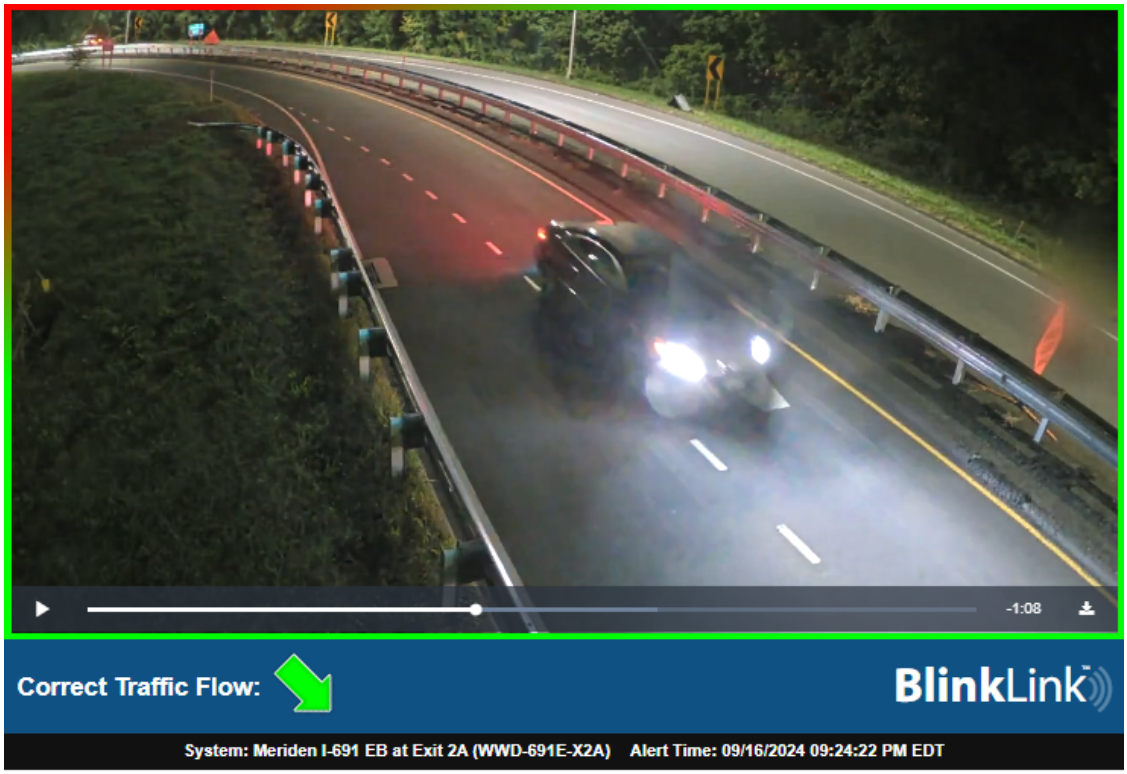
Conclusion

Highway Operations Center staff agrees that motorists should be notified when a wrong-way driver may be present, however does not recommend that VMS should be the chosen option for notification due to the narrow window where the wrong-way driver would pass the VMS and the message would no longer be applicable, and the 3.24 mile minimum gap where the right-way drivers would not be informed of the wrong-way driver. Alternatives should be considered and studied instead.

Operations Center staffing levels will need to be examined based on the number of wrong way driver employees to be staffed overnight. With the expansion of more different types of technology to monitor in the operations center, and larger geographic coverage throughout the state as more is deployed, one operator staffed overnight is unacceptable to ensuring operations runs as smoothly as possible.



September 16, 2024: A driver traveling up the off-ramp the wrong-way



September 16, 2024: The same vehicle travelling down the off-ramp in the correct direction about 40 seconds later