JOINT TRANSPORTATION
RESEARCH PROGRAM
INDIANA DEPARTMENT OF TRANSPORTATION
AND PURDUE UNIVERSITY

Worksite Speed Control System (WSCS)

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SPR-4933 • Report Number: FHWA/IN/JTRP-2025/33 • DOI: 10.5703/1288284318595

RECOMMENDED CITATION

Desai, J. C., Sakhare, R. S., McGregor, J., Sturdevant, J., & Bullock, D. M. (2025). *Worksite speed control system (WSCS)* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2025/33). West Lafayette, IN: Purdue University. https://doi.org/10.5703/1288284318595

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ACKNOWLEDGMENTS

Connected vehicle trajectory data used for this study was provided by StreetLight Data, Inc. Connected truck data used in this study was provisioned from Omnitracs. Commercial vehicle dash camera images for this study were provided by Vizzion. This work was supported by the Joint Transportation Research Program (JTRP) administered by the Indiana Department of Transportation (INDOT) and Purdue University. The authors would like to acknowledge the entire INDOT Safe Zones team, Modaxo-Elovate, Ben Snyder, Hannah Landvater, and Jijo Mathew for their integral efforts to this program and foundational work in this space that has been presented by this study.

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NOTICE

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. FHWA/IN/JTRP-2025/33	**2. Government Accession No.**	**3. Recipient's Catalog No.**
4. Title and Subtitle Worksite Speed Control System (WSCS)		**5. Report Date** November 7, 2025 **6. Performing Organization Code**
7. Author(s) Jairaj C. Desai, PhD (https://orcid.org/0000-0003-2885-203X) Rahul Suryakant Sakhare, PhD (https://orcid.org/0000-0001-7843-5707) John McGregor, PE James Sturdevant, PE (https://orcid.org/0000-0002-6077-6965) Darcy M. Bullock, PhD, PE (https://orcid.org/0000-0002-7365-1918)		**8. Performing Organization Report No.** FHWA/IN/JTRP-2025/33
9. Performing Organization Name and Address Joint Transportation Research Program Hall for Discovery and Learning Research (DLR), Suite 204 207 S. Martin Jischke Drive West Lafayette, IN 47907		**10. Work Unit No.** **11. Contract or Grant No.** SPR-4933
12. Sponsoring Agency Name and Address Indiana Department of Transportation (SPR) State Office Building 100 North Senate Avenue Indianapolis, IN 46204		**13. Type of Report and Period Covered** Final Report **14. Sponsoring Agency Code**

15. Supplementary Notes

Conducted in cooperation with the U.S. Department of Transportation, Federal Highway Administration.

16. Abstract

This study evaluates the effectiveness of Speed Safety Camera (SSC) deployments in reducing traffic speeds through four interstate work zones in Indiana in accordance with Indiana State Law House Enrolled Act (HEA) 1015. The initial deployment of SSC was along interstate I-70 in August 2024, with deployments on I-69, I-465, and I-65 subsequently following in 2025. To evaluate the impact of SSC deployments in Indiana, connected passenger car and connected truck data was used to quantify the change in speed characteristics before and during the SSC deployments. Approximately 100 million passenger vehicle records and 3 million commercial truck records were analyzed. That connected vehicle data was used to count the number of spot speeds, at 0.1-mile intervals, that were 11mph or more over the work zone speed limit over the entire work zone. The length of those study segments ranged from 3 to 10 miles. Across 443 SSC deployment days between August 14, 2024, and July 11, 2025, the study found 34% reductions on average in the percentage of passenger vehicle spot speeds exceeding the work zone speed limit by 11 mph or more on weekdays between 6AM-6PM. For commercial trucks, there was a 41% reduction across the study sites.

17. Key Words work zone, speed control, speed enforcement, speed cameras, connected vehicle data, performance measures, work zone safety	**18. Distribution Statement** No restrictions. This document is available through the National Technical Information Service, Springfield, VA 22161.

19. Security Classif. (of this report) Unclassified	**20. Security Classif. (of this page)** Unclassified	**21. No. of Pages** 27, including appendices	**22. Price**

EXECUTIVE SUMMARY

Motivation

Safety in construction work zones is an area of national concern for all stakeholders. Speed was a factor in 34% of fatal work zone crashes nationwide in 2022, a 2% increase from 2021 (Federal Highway Administration [FHWA], 2025; National Highway Traffic Safety Administration, 2025). Indiana alone reported 1,750 injuries and 8,285 total crashes in work zones in 2023 (Indiana Department of Transportation [INDOT], n.d.). Automated enforcement, visible law enforcement, speed feedback displays, and variable speed limits are some of the tools that agencies use to increase compliance with work zone speed limits and improve driver and worker safety.

A number of states including Maryland, Oregon, Illinois, Washington, and Pennsylvania are in the process of or already have piloted automated enforcement programs and have reported improvements in work zone safety. FHWA (2023) has identified Speed Safety Cameras (SSC) as a tool for improving roadway safety. A Minnesota Department of Transportation (2023) study found that as many as 20 states across the United States have employed SSC for reducing speeds in work zones and/or school zones. Practitioners have used a variety of techniques to evaluate the effectiveness of their work zone safety measure deployments ranging from crash reports (Guerra et al., 2024; Tilahun, 2022), monitoring with cameras, and speed monitoring devices (Mahmud et al., 2024). A five-month analysis of automated enforcement of three work zones in Pennsylvania using connected vehicle (CV) data from passenger vehicles observed an increase in overall speed compliance in work zones with the presence of SSC (Mathew et al., 2022).

Study

Indiana State Law House Enrolled Act 1015 authorized the use of SSC in Indiana. The first deployments were in 2024. The objective of this is to evaluate the effectiveness of SSC deployments in reducing traffic speeds through four interstate work zones in Indiana. This study used CV data to monitor speed characteristics of work zones and assess the impact of SSC using both passenger vehicle and commercial truck trajectory data. The control set of data was collected prior to deployment of SSC warning signs and active enforcement.

Results

Approximately 104 million passenger vehicle records and 3 million commercial truck records were analyzed. That connected vehicle data were used to count the number of spot speeds, at 0.1-mi intervals, that were 11 mph or more over the work zone speed limit over the entire work zone. The length of those study segments ranged from 3–10 mi. Across 443 SSC deployment days between August 14, 2024, and July 11, 2025, the study found 34% reductions on average in the percentage of passenger vehicle spot speeds exceeding the work zone speed limit by 11 mph or more on weekdays between 6:00 a.m.–6:00 p.m. For commercial trucks, there was a 41% reduction across the study sites. Although not as dramatic, there was significant reduction in speeds during periods when enforcement was not active and beyond the immediate location of the SSC sites.

Recommendations

The reporting framework developed in this study provides a robust tool for agencies to assess the impact of their SSC programs.

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1. PROJECT OVERVIEW

1.1 Introduction

Safety in construction work zones is an area of national concern for all stakeholders. Speed was a factor in 34% of fatal work zone crashes nationwide in 2022, a 2% increase from 2021 (Federal Highway Administration [FHWA], 2025; National Highway Traffic Safety Administration, 2025). Indiana alone reported 1,750 injuries and 8,285 total crashes in work zones in 2023 (Indiana Department of Transportation [INDOT], n.d.). Automated enforcement, visible law enforcement, speed feedback displays, and variable speed limits are some of the tools that agencies use to increase compliance with work zone speed limits and improve driver and worker safety.

A number of states including Maryland, Oregon, Illinois, Washington, and Pennsylvania are in the process of or already have piloted successful automated enforcement programs and have shown marked improvements in work zone safety. FHWA (2023) has identified Speed Safety Cameras (SSC) as a safety countermeasure for improving roadway safety. A Minnesota Department of Transportation (2023) study found that as many as 20 states across the United States have employed SSC for reducing speeds in work zones and/or school zones. Practitioners have used a variety of techniques to evaluate the effectiveness of their work zone safety measure deployments ranging from crash reports (Guerra et al., 2024; Tilahun, 2022), monitoring with cameras, and speed monitoring devices (Mahmud et al., 2024). Those evaluation efforts often require significant time and labor investment as well as extensive data collection periods. Connected Vehicle (CV) data have the potential to provide such evaluations on a near real-time basis and are not spatially constrained. With the use of CV data, SSC evaluations no longer need to be constrained to a particular location but can instead be performed across the worksite and beyond.

1.2 Scope and Objectives

The objective of this study is to use CV data to monitor speed characteristics of work zones and assess the impact of SSC. CV data have been utilized over the past decade to conduct systematic evaluations on the effectiveness of a number of work zone safety countermeasures including speed feedback displays (Mathew et al. 2021), queue warning trucks (Sakhare et al., 2021), work zone geometry (Mekker et al., 2018), among others. Moreover, a five-month analysis of automated enforcement of three work zones in Pennsylvania using CV data from passenger vehicles observed an increase in overall speed compliance in work zones with the presence of SSC (Mathew et al., 2022).

However, a systemwide long-term evaluation of a state's SSC deployments using both passenger vehicle and commercial truck trajectory data has not yet been performed. In some cases, passenger vehicle speed trends may differ significantly from commercial truck speeds based on road geometry, differential truck speed limits, and number of lanes, for example. This study was designed to provide a quantitative evaluation of the change in work zone speed characteristics with and without SSC over both time and location in the work zone.

1.3 Dissemination of Research Results

The following research paper was prepared in part during this project to facilitate an agile dissemination of results for public and private sector stakeholders:

- Desai, J., Sakhare, R. S., McGregor, J., Snyder, B., & Bullock, D. M. (2025). Evaluating impact of automated work site speed enforcement using connected vehicle data. *Applied Sciences, 15*(22), 12140. https://doi.org/10.3390/app152212140

A majority of the contents of this report are adapted from this research paper titled "Evaluating Impact of Automated Work Site Speed Enforcement Using Connected Vehicle Data" from Desai et al. (2022). Furthermore, the findings from this study were presented to stakeholders over the course of this project at various Study Advisory Committee (SAC) meetings, ad-hoc webinars, and engagement events. Additionally, weekly reports were provided by the research team to INDOT over the course of all active SSC deployments through SharePoint, starting the week of August 5, 2024, and through the week of December 15, 2025. The following sections of this technical report summarize the background and key findings of this research.

2. LITERATURE REVIEW

2.1 Background on Indiana's Pilot Program

Beginning in 2020, Indiana began looking at what other states were doing to manage work zone speeds and identified SSC as a technology to further investigate. Based on similar mature programs in Maryland (started in 2009) and Pennsylvania (started in 2020), INDOT colleagues met with their peers to learn how those systems were operated and managed.

The Indiana Legislature passed House Enrolled Act 1015 of 2023 and was signed by Governor Holcomb in May 2023. This legislation authorized INDOT to develop, implement, and operate a five-year pilot for a Worksite Speed Control Program. Officially termed the Worksite Speed Control System (WSCS) program by INDOT, the program development began in July 2023. Test deployments started in July 2024, and a "pre-enforcement" period where the program issued written Courtesy Notices began August 14, 2024, and continued through April 2025. Full program enforcement and issuance of actual violations began on May 5, 2025.

The Program provides motorists with notice of enforcement locations through press releases prior to enforcing in a given worksite (WS) as well as both long-term and short-term signs at the actual enforcement location. Enforcement units (henceforth referred to as *SSC units*) are vehicle-based with speed detection and image capture LiDAR devices to measure vehicle speeds and capture images of vehicles traveling in excess of the threshold speed, which is 11 mph or more over the posted worksite speed limit. These images are then encrypted and transferred to the back office where the images are reviewed and the registered

owner is sought. Once the registered owner is identified, a notice of violation is created and issued. The penalty structure for the program is a zero-fine warning for the first violation, a $75 civil penalty for the second violation, and a $150 civil penalty for the third and subsequent violations. The registered owner has the right to contest their liability for any SSC violation through established processes with the Office of Administrative Law Proceedings (OALP).

3. INDIANA WSCS DEPLOYMENT

3.1 Study Location

Figure 3.1 shows a map view of the four worksites analyzed by this study along Interstate 70 (I-70; Callout A), Interstate 69 (I-69; Callout B), Interstate 465 (I-465; Callout C), and Interstate 65 (I-65; Callout D). The first three worksites were located in the greater Indianapolis area in Marion and Hancock Counties, while the most recent I-65 worksite is located in northwest Indiana in Lake County. The I-70 worksite spanned 10 mi, followed by the I-465 worksite at 5 mi, the I-65 worksite at 3.8 mi and the I-69 worksite at 3 mi. A 3-mi buffer was added both upstream and downstream of each worksites' mile marker (MM) limits to capture spillover impacts in the immediate vicinity of the worksite, as well.

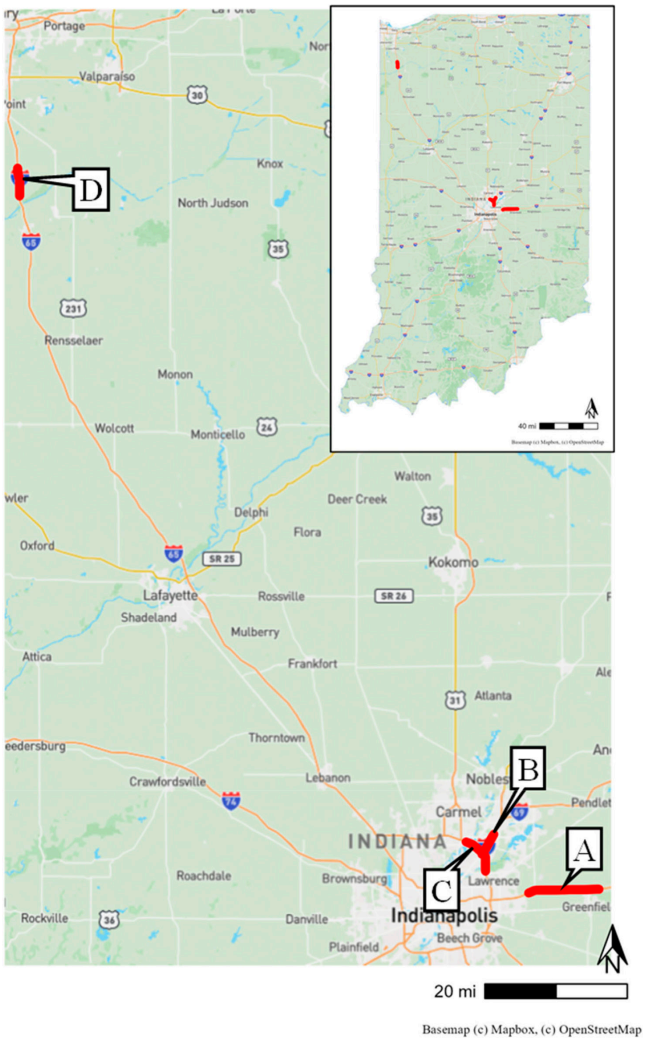


Figure 3.1 Map Showing the Four Deployment Locations for SSC in 2024 (A) and 2025 (B, C, and D).

3.2 Placement of Advance Warning Signage

Figure 3.2a illustrates the location of the vehicle with the SSC (Callout i), the placement of an "ACTIVE" sign provided as a courtesy to motorists (Callout ii), and an advance warning sign (Callout iii). Figure 3.2b provides a front view of the vehicle with SSC used to obtain enforcement data. Figure 3.2c show an image of the portable "ACTIVE" sign, 4 ft wide by 4 ft tall, that is only placed during active deployments. Figure 3.2d shows a ground-mounted active warning sign, 4 ft wide by 5 ft tall, that is continuously visible to motorists. An additional advanced warning sign—either a panel 9 ft wide by 7 ft tall or smaller 4 ft wide by 5 ft tall sign is placed in advance of the advanced warning sign at the location shown in Figure 3.2a, Callout iii, also continuously visible to motorists.

3.3 Chronological Summary of SSC Deployments

Table 3.1 provides a chronological view of the four worksites and the order in which SSC units were deployed to each.

- The I-70 worksite (Figure 3.1, Location A) was the first deployment with a pre-enforcement period from August 14, 2024, to December 20, 2024, in both directions of travel (eastbound [EB] and westbound [WB]).
- The subsequent I-69 deployments (Figure 3.1, Location B) were only deployed in the southbound (SB) direction and assessment was done from January 15, 2025 (Clear Path 465, 2024), through July 11, 2025.
- The I-465 deployments (Figure 3.1, Location C) were deployed in both directions of travel (clockwise Inner Loop [IL] and counter-clockwise Outer Loop [OL]) and assessed from January 15, 2025, through July 11, 2025.
- The most recent worksite I-65 deployments (Figure 3.1, Location D) were in the southbound direction of travel and assessed from July 7, 2025 (Indiana Safe Zones, 2025), through July 11, 2025.

The WSCS program remains active beyond these reporting dates, but these dates were selected to provide time for analysis, reporting, and results within the evaluation project period. Consequently, the study period was limited to end on July 13, 2025, and the data and results reported herein are current as of that date.

The following section describes the SSC setup for the I-70 worksite in the eastbound direction of travel. The other worksites followed a similar setup. The I-69 and I-465 worksites had posted worksite speed limits of 45 mph, while I-70 and I-65 had posted worksite speed limits of 55 mph. Subsequent sections describe the speed analysis with and without SSC deployments.

(a) Active SSC on I-465 Worksite

(c) Active SSC Portable Sign (From Figure 3.2a, Callout ii)

(b) SSC Vehicle (From Figure 3.2a, Callout i)

(d) Upstream Fixed Signs (From Figure 3.2a, Callout iii)

Figure 3.2 INDOT Safe Zones Worksite Speed Control Pilot Program (Desai et al., 2025).

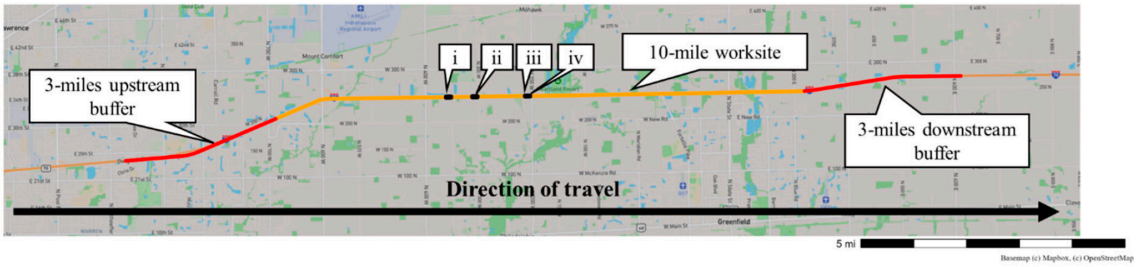
TABLE 3.1
Chronological Order of Worksite Deployment Across Pre-Enforcement and SSC Periods.

	Month/Year												
Worksite	**08/24**	**09/24**	**10/24**	**11/24**	**12/24**	**01/25**	**02/25**	**03/25**	**04/25**	**05/25**	**06/25**	**07/25**	**08/25**
(A) I-70	P	P	P	P	P								
(B) I-69						P	P	P	P	MW	MW	MW	MW
(C) I-465						P	P	P	P	MW	MW	MW	MW
(D) I-65												MW	MW

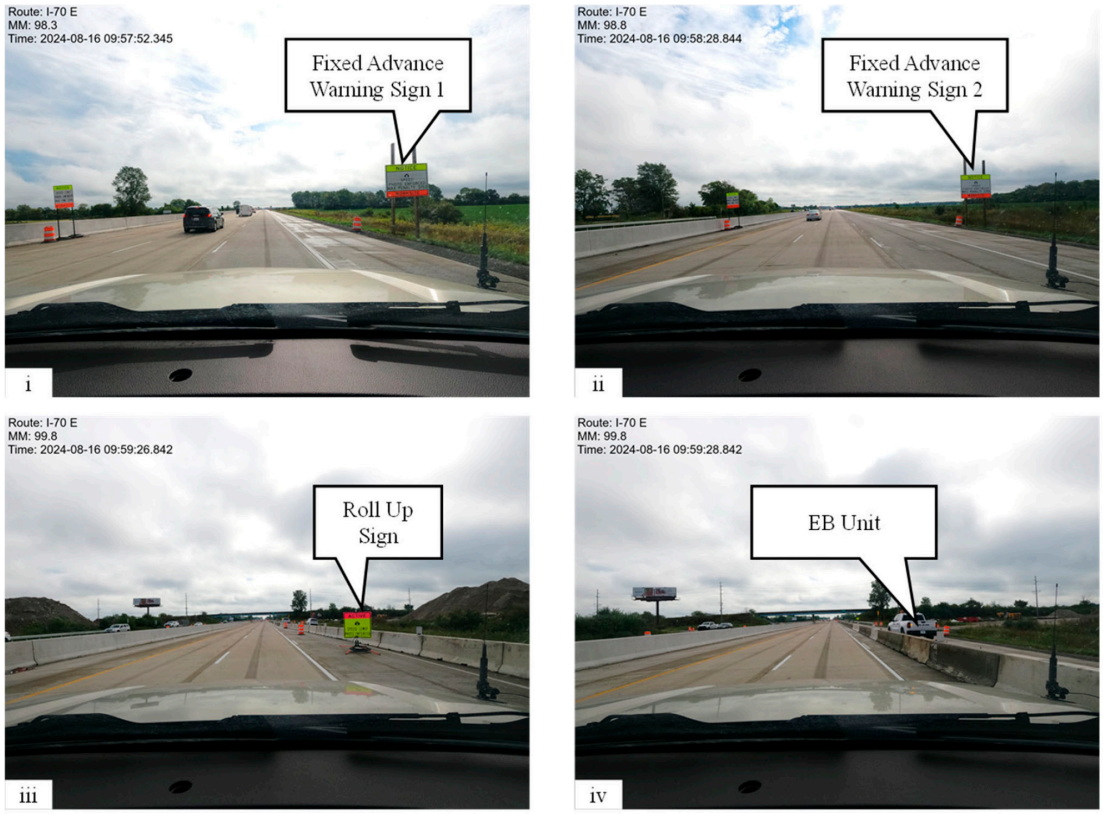
P: Pre-Enforcement Period; MW: Warnings Mailed and Full Fine-Carrying Violations

3.4 Example of I-70 EB Worksite Configuration and Segment Definitions

Figure 3.3a shows the linear definition of a 10-mi worksite with 3-mi buffers on each end on I-70 EB in Hancock County, Indiana. Figure 3.3b shows a corresponding windshield view from a vehicle. The first fixed advance warning (Callout i) sign alerting motorists of SSC activity was placed 1.5 mi upstream of the SSC location. The second such advance warning sign (Callout ii) was placed about 1 mi upstream of the SSC location. These two fixed advance warnings signs carried the following message "NOTICE | SPEED PHOTO ENFORCED MAX PENALTY $150 | WORKSITE," as shown by Figure 3.3b. Finally, a third portable temporary sign (Callout iii) was placed in very close proximity upstream of the SSC unit (Callout iv) at any time that the unit was active, with the following message to motorists "ACTIVE | SPEED LIMIT PHOTO ENFORCED."



(a) I-70 EB MM 95–105 Worksite Location



(b) Advance Warning Signs and Unit Setup for EB Worksite

Figure 3.3 Advance Warning Signage on Approach to I-70 EB Mount Comfort Worksite MM 95–105.

4. DATA DESCRIPTION

This section describes the data used to analyze approximately 104 million passenger vehicle records and 3 million commercial truck records to identify spot speed characteristics of those two classes of vehicles between August 2024 and July 2025. Details are explained on how spot speed proportions for 0.1-mi long segments are computed. The evaluation focuses on summarizing the percentage of speed records exceeding worksite speed limit by 11 mph or more by day by hours (active/scheduled SSC hours or 24 hr categorized into five periods). This hourly data summary can then be used to compare speed characteristics during different periods of day and assess impact of SSC.

The flow chart shown in Figure 4.1 provides an overview of the data flow and coordination among stakeholders.

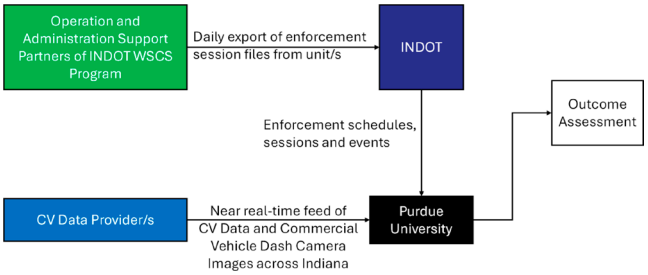


Figure 4.1 Data Collection Workflow.

4.1 Connected Vehicle Data

Anonymous CV data were obtained for this study from third-party providers covering both passenger cars as well as commercial trucks. Trajectory waypoints from passenger cars available at 3-s frequency, and those from commercial trucks available at 10–60-s frequency were utilized for this analysis. Through spatial joining and linear referencing techniques described in existing literature (Desai et al., 2021, 2022; Mathew et al., 2022), each such waypoint was linearly referenced to its corresponding MM location in its direction of travel. To filter any outlier speeds, reporting inaccuracies in the CV data, or slow-moving traffic due to incidents and recurring congestion, only speeds greater than 25 mph and lower than 120 mph were considered for this analysis. These CV data sources together approximately account for an overall penetration of 5–6% on noninterstate and interstate roads (Sakhare et al. 2022) with commercial truck records providing higher visibility during overnight hours when there is naturally low passenger vehicle volume.

4.2 Deployment Logs

INDOT's WSCS Program Vendor provides operational and administrative support to INDOT and provided Deployment Logs (DLs) used to identify analysis periods in this study. The DLs provide deployment information—specifically date, time, and precise location information where the SSC units were deployed. SSC deployment times provide context for before and after comparisons of speeds during active SSC deployments compared to pre-SSC-deployment construction times. SSC device geolocations were linearly referenced to match them to a corresponding MM and travel trajectory for a particular worksite. This information was used to identify the locations for performing analysis of the impact of the SSC.

Figure 4.2 utilizes these DLs to plot start and end times of SSC deployment sessions on the I-70 worksite. The time of day from 6:00 a.m.–6:00 p.m. is visible on the vertical axis while the date is visible on the horizontal axis. The visual is limited to only this 12-hr timeframe for simplicity, as there were no overnight SSC deployments during the study period. Dashed horizontal lines at 7:00 a.m. and 5:00 p.m. are meant to indicate general times within which SSC were generally deployed. In general, most deployments began around 8:00 a.m. and ended by 4:00 p.m.

Figure 4.3, Figure 4.4, and Figure 4.5 similarly show deployment times by date for the I-69, I-465, and I-65 worksites, respectively. All times are indicated in Eastern time for simplicity, although the I-65 worksite is located in the Central time zone. I-69 deployments initially began with the 7:00–11:00 a.m. planned schedule and then moved to a 10:00 a.m.–2:00 p.m. schedule.

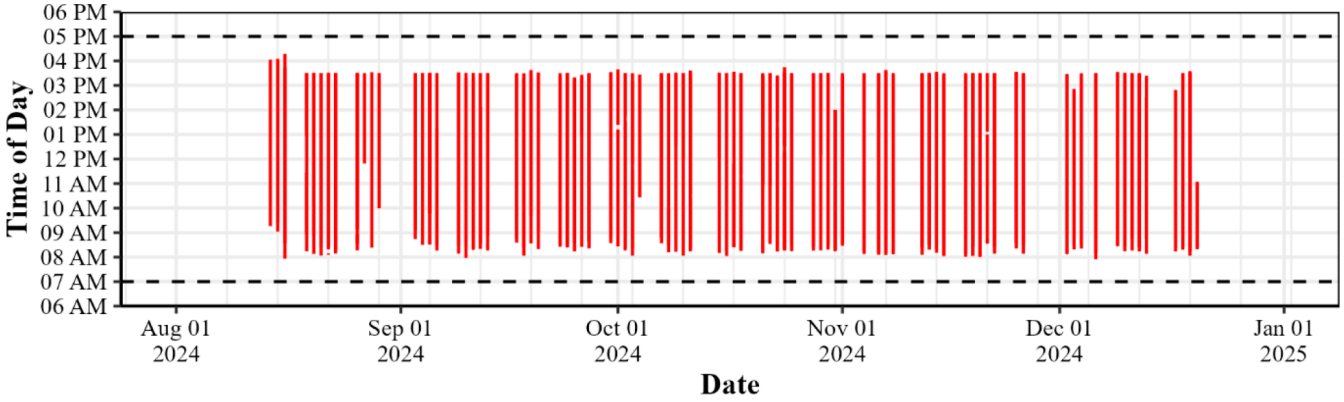


Figure 4.2 I-70 WS Deployment Times From August 2024 to December 2024.

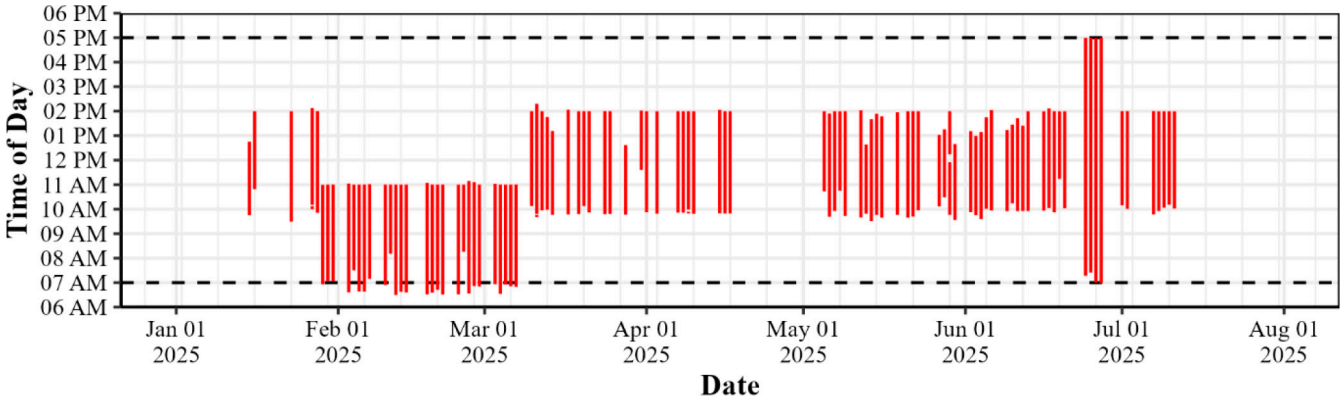


Figure 4.3 I-69 WS Deployment Times From January to July 2025.

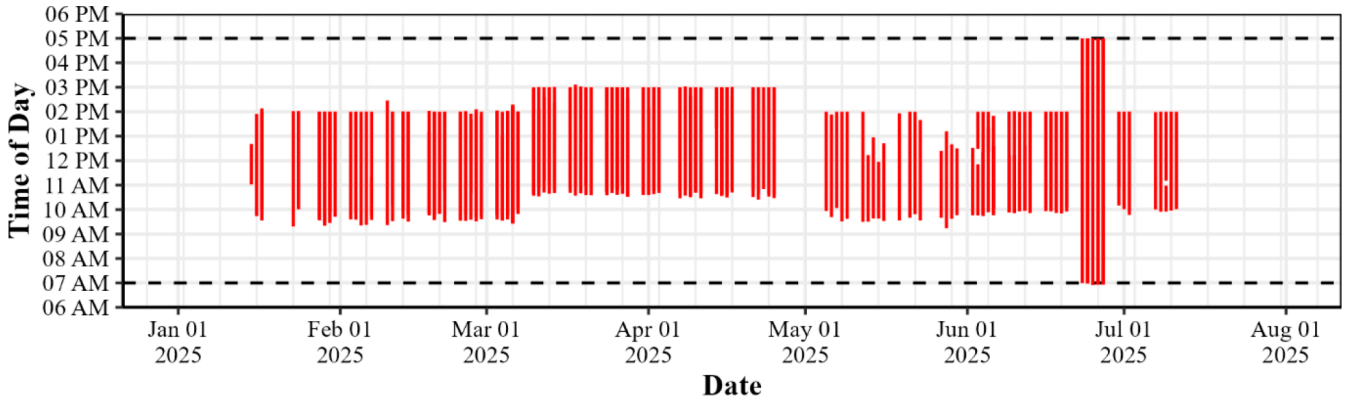


Figure 4.4 I-465 WS Deployment Times From January to July 2025.

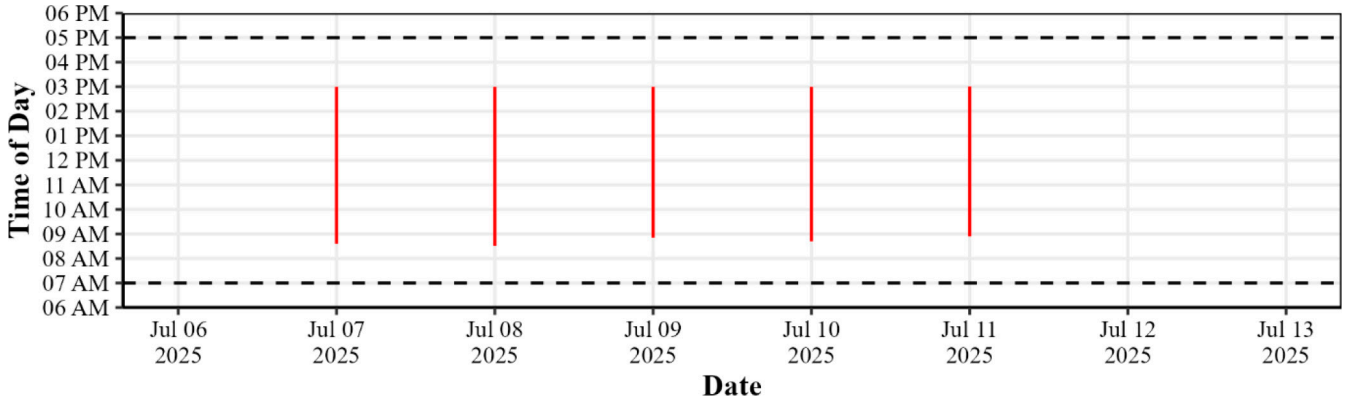


Figure 4.5 I-65 WS Deployment Times During July 2025.

Similarly, I-465 deployments varied between the 10:00 a.m.–2:00 p.m. or 11:00 a.m.–3:00 p.m. timeframes. For the first week of its deployments, I-65 observed active SSC between 9:00 a.m.–3:00 p.m. Eastern time.

4.3 Fixed Panel Advance Warning Signs

In coordination with the agency and construction staff, installation dates and locations of fixed advance warning signs on each worksite were obtained. These installation dates helped the analysis in defining a "before" control period where no signage pertinent to SSC was present within the worksite. Commercial vehicle dash camera images (Sakhare et al., 2024) as well as field visits (video drive throughs) of each worksite were used to validate and record these sign installation locations.

5. METHODOLOGY

To systematically analyze the study area through manageable segments that are granular enough to capture the specific impacts of unit placement at a MM, while not being coarse enough to wash out localized impacts, a 0.1-mi segment resolution was chosen. CV speed records were linearly referenced and matched to the corresponding 0.1-mi segment they spatially lie within, and an MM was assigned to each CV waypoint. For purposes of illustration, passenger vehicle CV data are utilized for the results presented in this section. Summary statistics for commercial trucks are included at the end of the report using this same methodology.

5.1 Processing CV Data for Hours of Active SSC

5.1.1 Evaluating Speed Compliance for One Day

Figure 5.1 shows a speed proportion plot for the I-70 EB worksite for one active SSC day on Friday, September 20, 2024. The horizontal axis represents the MM location along the worksite beginning from MM 92–108. Every 0.1-mi segment of roadway is represented by a 100% stacked bar chart made up of three categories of CV speed records, namely, within worksite speed limit (< = 55 mph), within worksite speed limit tolerance (< 66 mph), and over the worksite speed limit tolerance (> = 66 mph). Each vertical column represents a stacked percentage of CV speeds in each of these three categories.

Figure 5.1 Callout i and ii represent the MM locations of the two fixed advance warning signs installed in this worksite. Callout iii represents the MM location of the temporary portable sign and the SSC unit. Callout iv indicates the actual worksite

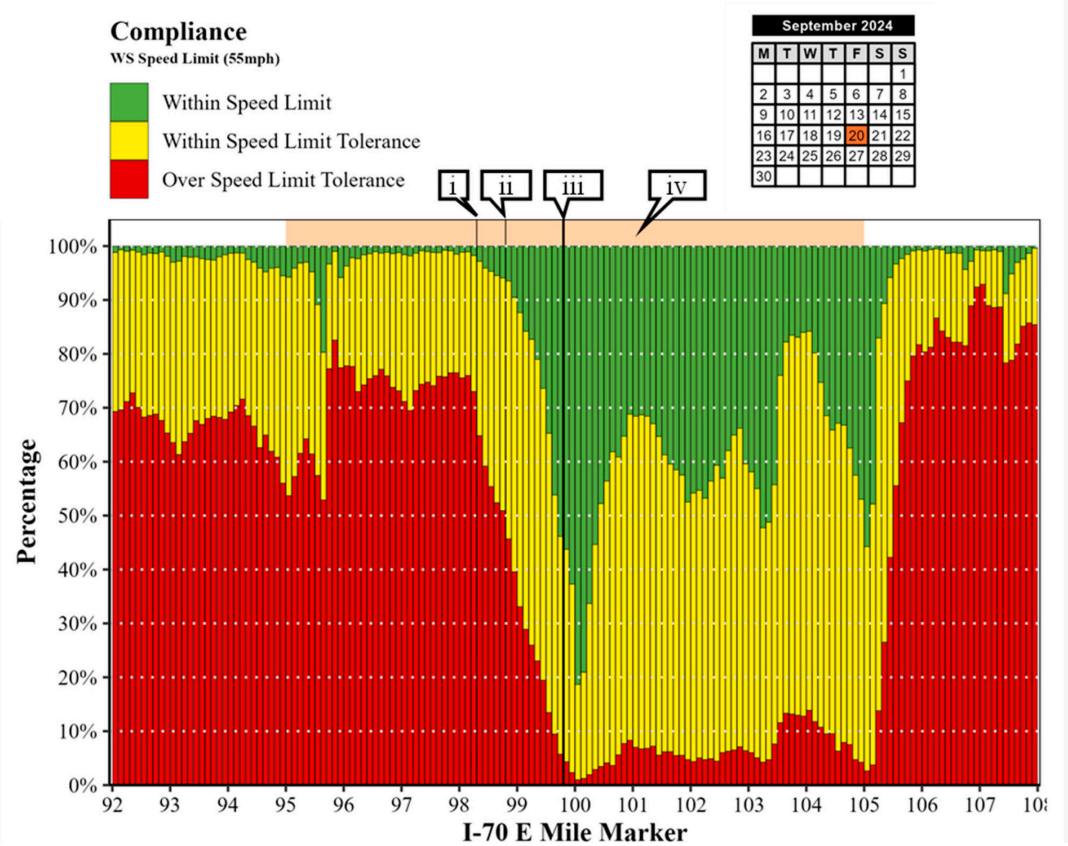


Figure 5.1 Passenger Car Speed Profiles for I-70 EB Worksite (Friday, September 20, 2024).

MM limits of MM 95–105 denoted by the shaded orange background. Thin vertical black lines denote the advance warning sign locations. The SSC unit's location is similarly marked by a thick black vertical line on the diagram. CV speeds clearly show the highest compliance with WS speed limit tolerance as they get closer to the SSC unit location MM. This compliance is sustained for a significant portion of the work zone with speeds increasing on entering the downstream 3-mi buffer. The trend in speeds over the WS speed limit tolerance decreasing appears to begin exactly at the MM location of the first advance warning sign at MM 98.3 and continues to decrease all the way until the SSC unit's location.

The SSC unit was deployed on this date from about 8:19 a.m. to 3:32 p.m. Eastern Time. Approximately 181,000 CV speed records during this exact timeframe were extracted, aggregated, and plotted in Figure 5.1. At the exact location of the SSC unit, MM 99.8, only 4.3% of CV speed records were observed to be 11 mph or higher than the WS speed limit (55 mph). Correspondingly, that percentage is as high as 64.8% at the location of the first fixed advance warning sign at MM 98.3 and 45.7% at the location of the second fixed advance warning sign at MM 98.8. This shows the gradual change in speed trends as motorists approach the first two fixed advance warning signs and, eventually, the SSC unit itself.

5.1.2 Evaluating Speed Compliance for Multiple Days

A four-day speed compliance plot for the same worksite from Friday, September 20 through Monday, September 23, 2024, is shown by Figure 5.2. For days with no active SSC, Saturday (b) and Sunday (c), similar time periods as the usual scheduled SSC times (8:00 a.m.–4:00 p.m.) are chosen for a more direct comparison of speed compliance. On days with active SSC, Friday (a) and Monday (d), the percentage of speeds exceeding the WS speed limit by 11 mph or more ranged from 4.3–4.6%. The same location witnessed percentages as high as 15.4% and 10.4% with no active SSC on Saturday (b) and Sunday (c) respectively, indicating a weekend rebound in speeds.

5.2 Processing CV Data for All 24 Hours

Additionally, CV data for all 24 hours on days with active SSC deployment ("after") as well as a set of days before any SSC deployment or advance warning sign installation ("before") were also processed for a more holistic before-after comparison of speed reductions not only during hours of, and at SSC unit or sign locations, but to also measure the spatial and temporal spillover impacts into the rest of the worksite as well as the remaining hours of the day. These results are presented in Section 6.2.

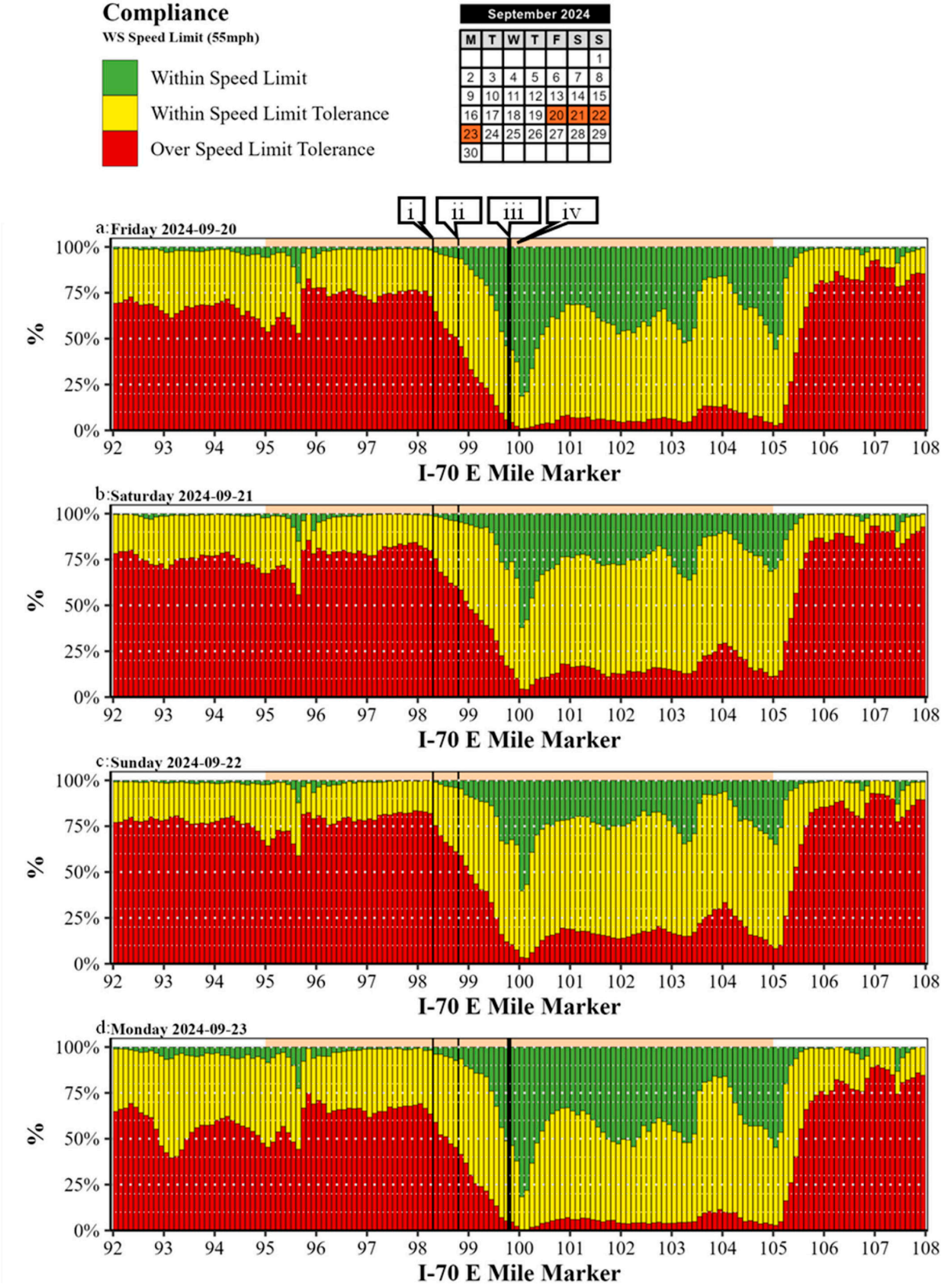


Figure 5.2 Passenger Car Speed Profiles for I-70 EB Worksite (September 20–23, 2024).

6. RESULTS

6.1 Hours of Active SSC

The following subsections present analysis results for hours of active SSC on longitudinal trends in speed compliance at the SSC unit location, the advanced warning sign locations, as well as the full worksite.

6.1.1 Longitudinal Trends in Speed Compliance at Sign and SSC Unit Locations

Similar analyses of speed compliance trends can be performed over a multiweek and even months-long time period to gain insights on longitudinal changes or patterns in speed compliance. Figure 6.1 shows a five-month plot of speed compliance trends (percent of speeds 11 mph or more over WS speed limit) at the MM locations of the two fixed advance warning signs as well as the various MM locations along the WS where the SSC unit was deployed over the course of the pre-enforcement period.

Callout i points to the date August 13, 2024, on which advance warning signs were installed on the worksite on I-70 EB in Hancock County, Indiana, with the first SSC session beginning the next day (Indiana Safe Zones, n.d.). The solid black line indicates a daily value of the percentage of speed records detected in the SSC unit's MM location that were 11 mph or more above the WS speed limit. Similarly, the solid blue and pink lines indicate this percentage of speed records at the MM location of the first and second fixed advance warning sign, respectively. Shaded regions of the plot indicate days on which active SSC was present, with the color of the shaded region representing one of four unique MM locations where the SSC unit was situated over this worksite's five-month study period.

Out of a total of 78 unique deployment days (81 sessions) on I-70 EB, the earliest recorded start time of a deployment was 7:54 a.m., while the latest recorded end time of a deployment was 4:17 p.m. A significant majority of the deployment sessions were nominally active in the 8:00 a.m.–3:30 p.m. timeframe. I-70 EB witnessed active SSC for a total of 78 unique days in the period ranging from August 14–December 20, 2024.

A decrease in the percentage of speeds (at or more than 11 mph above the WS speed limit) is evident on days of active SSC from Figure 6.1 with rebounds seen over the weekend (Callout ii). Sustained periods of absence in active SSC led to a more significant rebound in the percentage of CV speed records at or more than 11 mph above the WS speed limit at the unit location (Callout iii). Of particular note is the trend in decrease of speeds moving from the location of the first advanced warning sign to the second and finally to the SSC unit location highlighting the importance of positioning sufficient advance warning signage to give motorists enough notice to be able to reduce their speeds when entering a worksite.

For days with no active SSC, a similar procedure for selecting hours of the day for analysis that corresponds to the usual scheduled SSC times was followed as outlined in Section 5.1.2; 8:00a.m.–4:00p.m.wasthetimeperiodforI-70,10:00a.m.–2:00p.m. for I-69 and I-465, and 9:00 a.m.–3:00 p.m. for I-65. These times correspond well to the usual deployment times recorded in Figure 4.2, Figure 4.3, Figure 4.4, and Figure 4.5. For SSC unit MM selection, the last known (or first known in case of the period before first SSC deployment) location of the SSC unit was used until a new SSC unit MM was observed in the DLs. A similar visual for the other direction of travel on the I-70 WS has been depicted in Figure 6.2. Corresponding such visuals have also been generated for all other worksites for their respective study periods with a "before" period shown for comparison on speed drops before and during active SSC. These longitudinal trends for the I-69, I-465, and I-65 worksites have been summarized in Figure 6.3, Figure 6.4, Figure 6.5, and Figure 6.6. An expected increase in speed compliance is seen during active SSC with rebounds observed during the weekend for all worksites.

6.1.2 Longitudinal Trends in Speed Compliance for Entire Worksite

Figure 6.7 shows a similar visualization but considers all 10 mi of the I-70 worksite in each direction of travel for calculating daily percentages of CV speed records over the WS speed limit and over the WS speed limit tolerance. Similar rebounds over each weekend are seen in percentage of speeds higher than the tolerance with numbers going down during days of active SSC. It is encouraging to see that the impact of SSC propagates to the entire worksite and is not spatially limited to the locations where the SSC unit is positioned. Callout ii points to the same weekend highlighted by the detailed speed proportion plots earlier in Figure 6.1.

6.2 24 Hours

The preceding text showed detailed insights into the spatial and temporal impacts of SSC activity on the I-70 worksite during hours of active SSC. Widely available CV data can be utilized to document speed reductions across the entire worksite over all 24 hr of the day to understand if the impacts of an SSC session spillover into the remaining miles of a worksite and the remaining hours of a day when no SSC unit is present. As all SSC deployments were only carried out on weekdays when workers were present at the worksite, CV data from only weekdays are considered for this part of the analysis for a more direct before–after comparison.

In order to obtain a more holistic view of speed compliance trends within a worksite and an SSC unit's impacts outside of actual SSC times, a 24-hr analysis of speed compliance trends is presented in this section. Five different time periods are defined covering the 24 hr: 12:00–6:00 a.m., 6 :00–10:00 a.m., 10:00 a.m.–2:00 p.m., 2:00–6:00 p.m., and 6:00 p.m.–12:00 a.m. The first and final periods witnessed no active SSC during the analysis period but served to provide a glimpse into the rollover impact, if any, of active SSC into the overnight hours. All SSC activities were performed in one or more of the middle three time periods from 6:00 a.m.–6:00 p.m.

Similar to the analysis presented in Figure 5.2, a more complete comparison can be conducted by pulling CV data for all 24 hr within each worksite, categorizing them into the five time periods, and computing aggregate percentage values of the number of CV speed records that are 11 mph or more over the

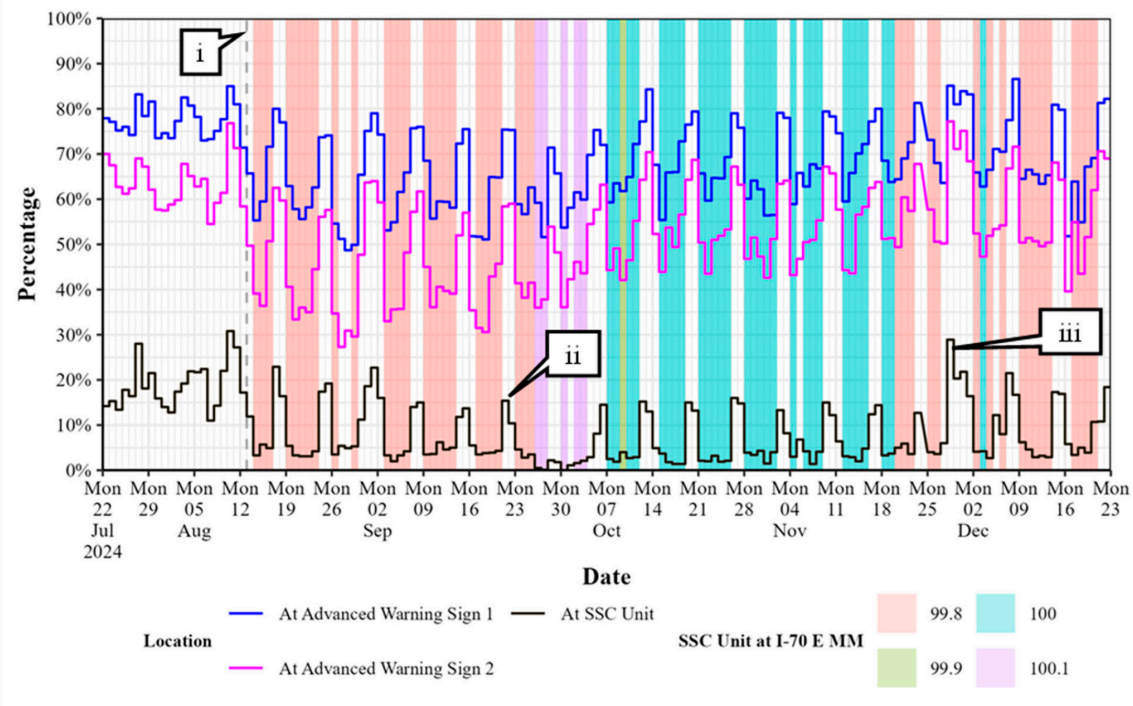


Figure 6.1 Longitudinal Trends on Speed Compliance (Percent at or More Than 11 mph of WS Speed Limit) at Advance Warning Signs and SSC Unit Locations for I-70 EB Worksite.

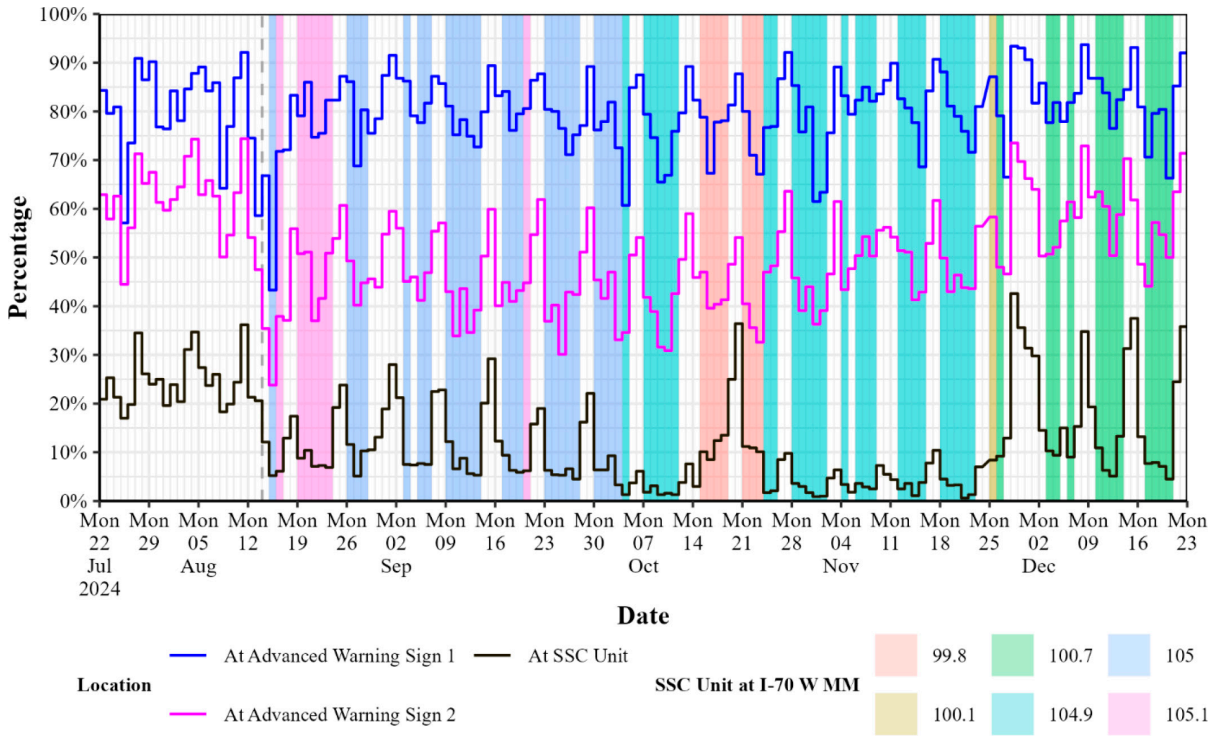


Figure 6.2 Longitudinal Trends on Speed Compliance (Percent at or More Than 11 mph of WS Speed Limit) at Advance Warning Signs and SSC Unit Locations for I-70 WB Worksite.

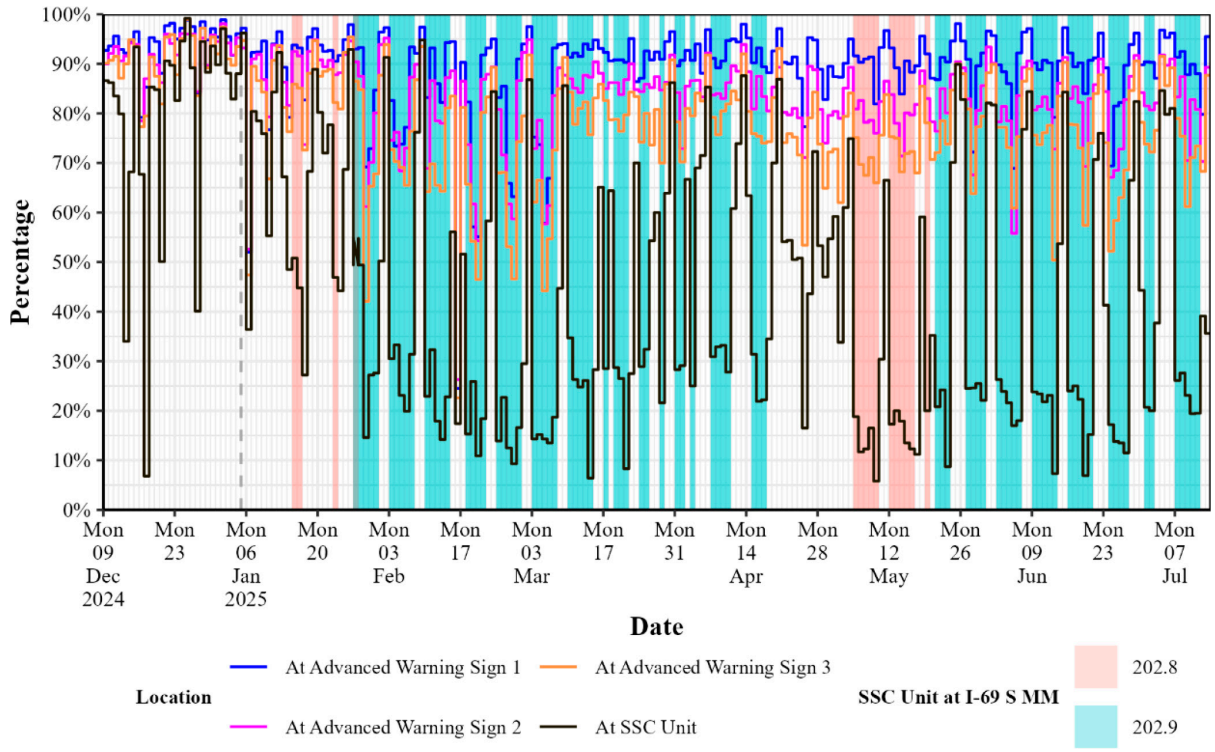


Figure 6.3 Longitudinal Trends on Speed Compliance (Percent at or More Than 11 mph of WS Speed Limit) at advance Warning Signs and SSC Unit Locations for I-69 SB Worksite.

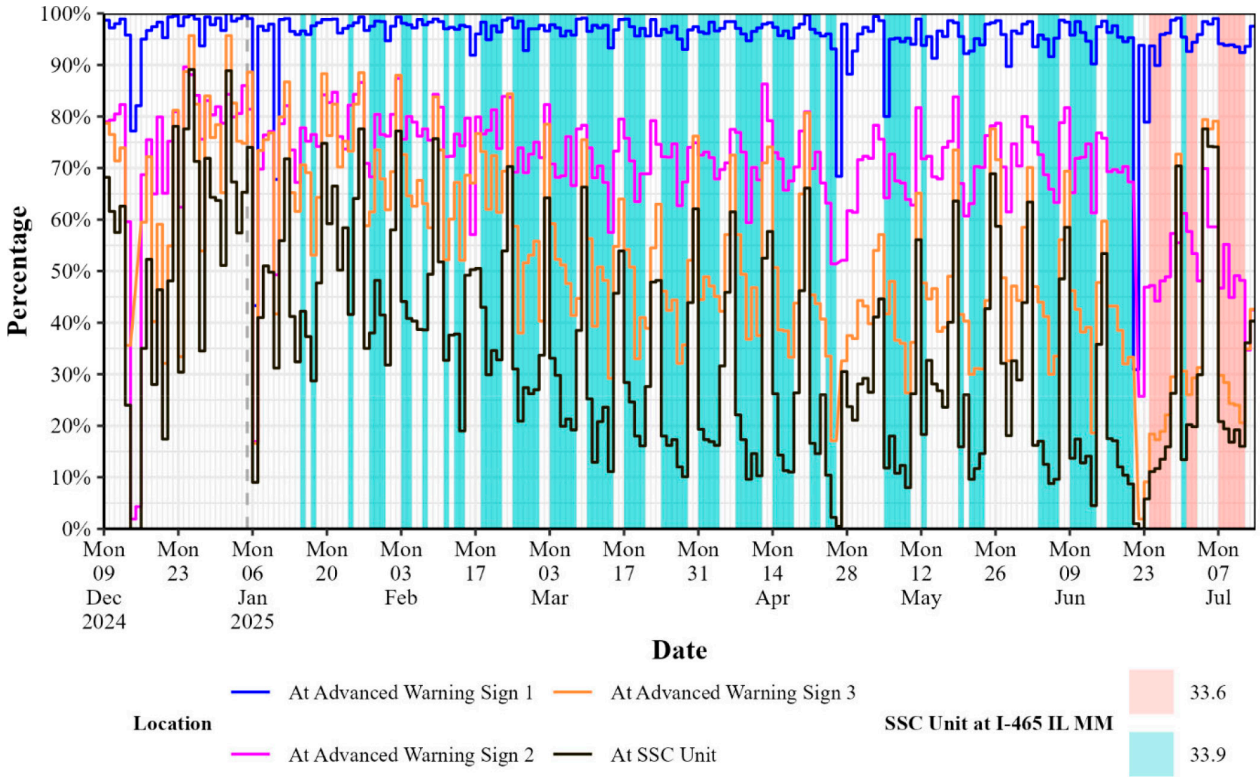


Figure 6.4 Longitudinal Trends on Speed Compliance (Percent at or More Than 11 mph of WS Speed Limit) at Advance Warning Signs and SSC Unit Locations for I-465 IL Worksite.

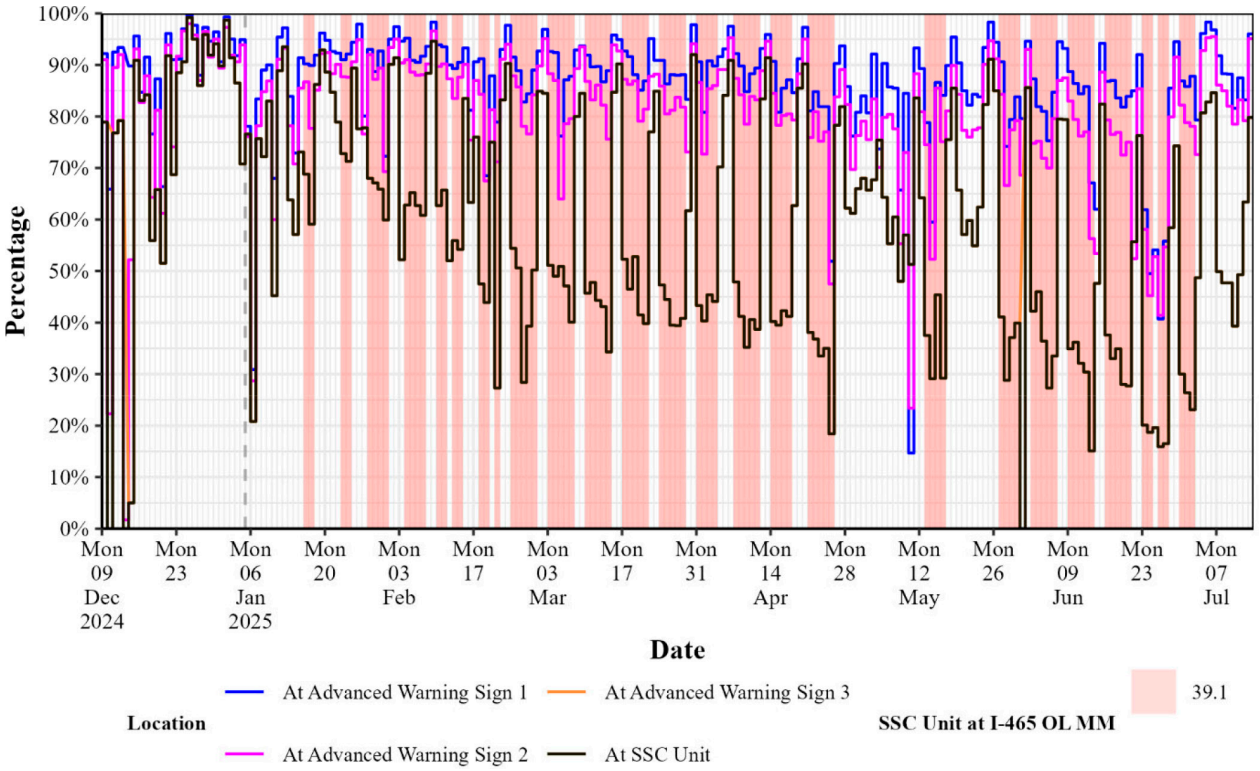


Figure 6.5 Longitudinal Trends on Speed Compliance (Percent at or More Than 11 mph of WS Speed Limit) at Advance Warning Signs and SSC Unit Locations for I-465 OL Worksite.

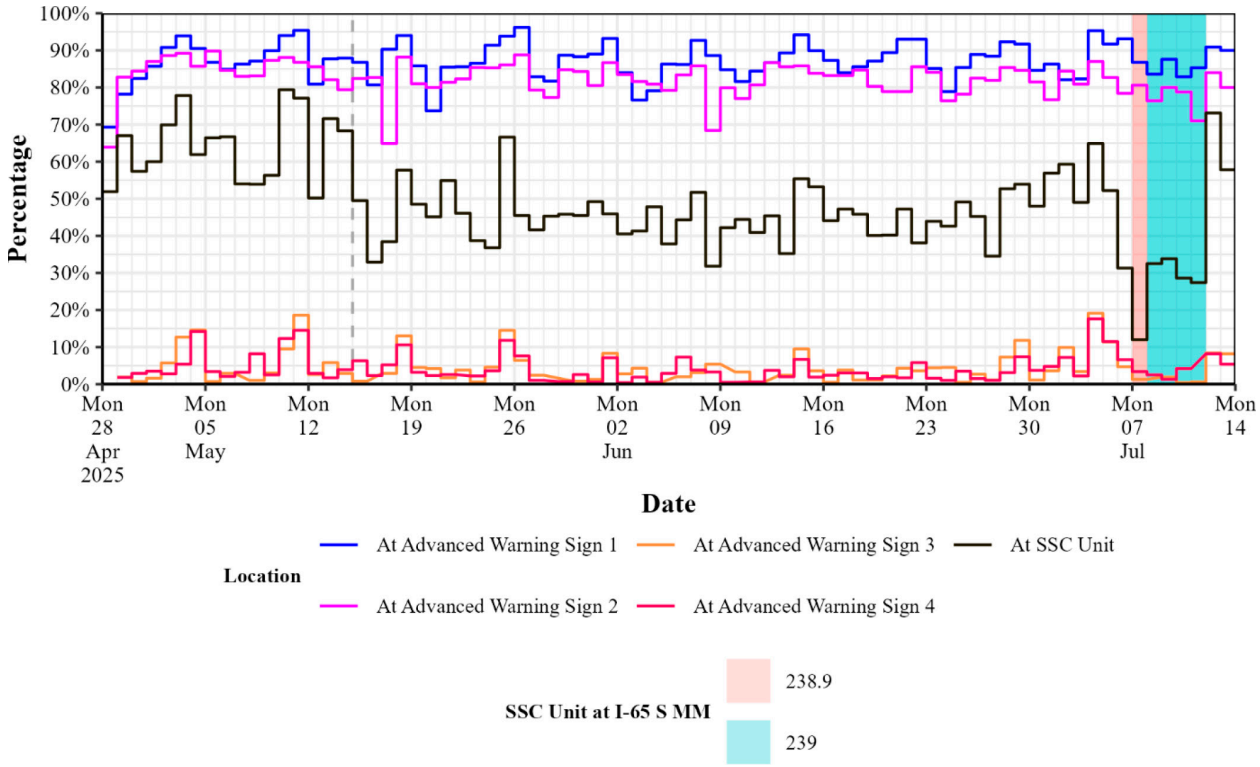


Figure 6.6 Longitudinal Trends on Speed Compliance (Percent at or More Than 11 mph of WS Speed Limit) at Advance Warning Signs and SSC Unit Locations for I-65 SB Worksite.

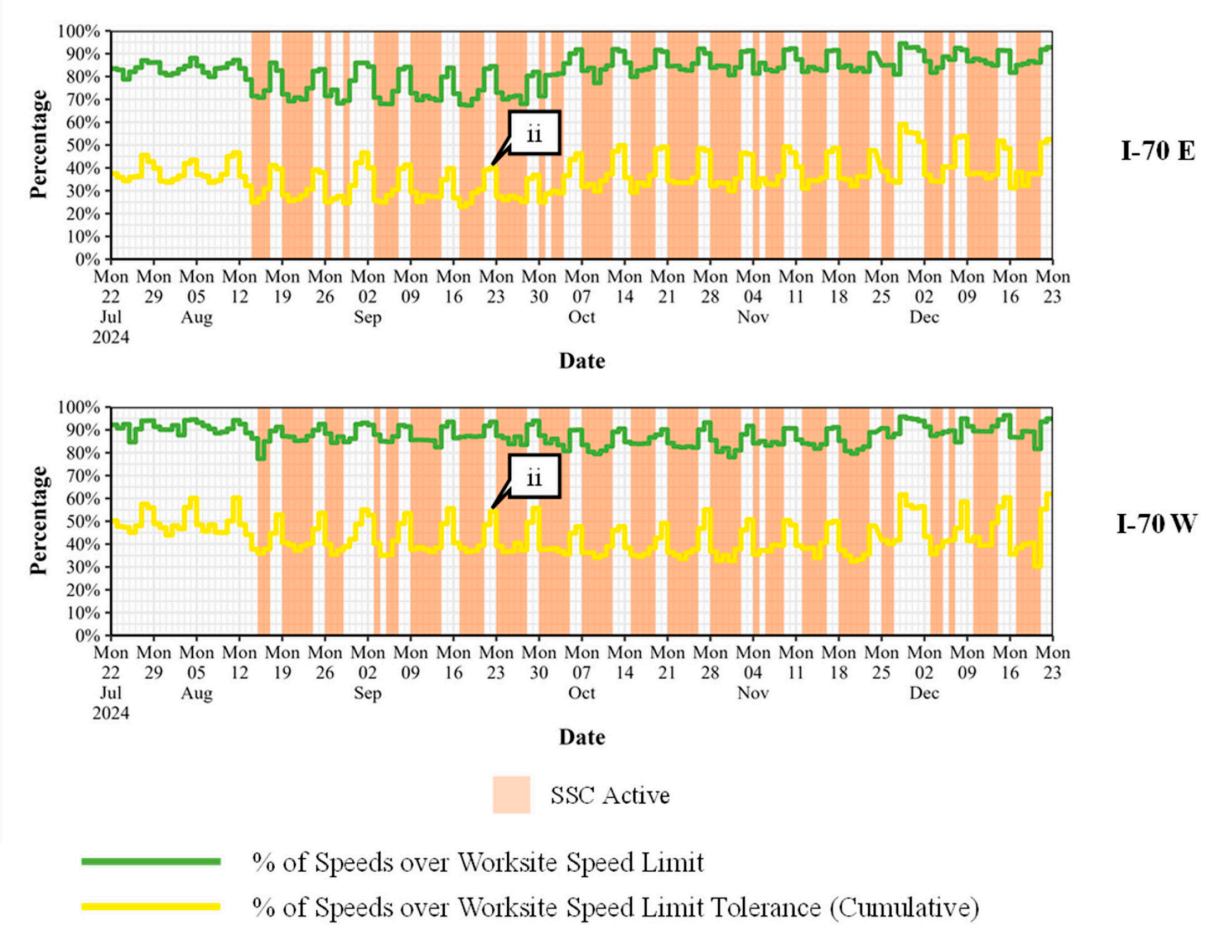


Figure 6.7 Longitudinal Trends on Speed Compliance for Entire I-70 Worksite MM 95–105.

WS speed limit. These percentages for passenger vehicle speeds as well as commercial truck speeds are shown by Figure 6.8 and Figure 6.9, respectively.

The "before" time period in each case refers to weekdays before any fixed signs were installed and before any active SSC was begun in the worksite. The "after" time period in each case refers to weekdays where active SSC was performed in the worksite with advance warning signs installed. The "before" period for each route includes data from 13 (I-65 SB), 16 (I-70 EB), 17 (I-70 WB) and 20 (I-69 SB, I-465 IL, I-465 OL) days. The "After" period contains varying day counts based on the number of active deployments as shown by the last column in Table 6.1 and Table 6.2. A total of 104 million passenger vehicle records and 3.3 million commercial truck records were utilized for this 24-hr analysis across all worksites.

Among passenger vehicles, the percentage of CV speed records 11 mph or more than the WS speed limit prior to any sign installation and SSC ranged from 41–65% on average across all worksites and time periods. Correspondingly, for days of active SSC, these numbers ranged on average from 28–56% across all worksites and time periods.

For passenger vehicles, the two largest absolute drops in percentage of speed records 11 mph or more than the WS speed limit were seen on the I-465 IL worksite for the 6:00–10:00 a.m. (drop from 58% to 27%) and 10:00 a.m.–2:00 p.m. (drop from 52% to 23%) time periods.

Correspondingly, for commercial trucks, the two largest absolute drops were seen on the I-69 SB worksite (drop from 22% to 4%) and the I-465 IL worksite (drop from 24% to 7%), both in the 6:00–10:00 a.m. time period.

In each case, the most significant reductions are seen in the time periods from 6:00 a.m.–6:00 p.m. which is when 100% of the active SSC sessions took place.

In general, and as evidenced by Figure 6.8 and Figure 6.9, the percentage of commercial truck speeds 11 or more mph above the WS speed limit are significantly lower than that of passenger vehicles. On average across all worksites and time periods, the percentage of commercial truck speed records 11 mph or more than the WS speed limit were 19.3% before compared to 13.6% after. Correspondingly, for passenger vehicles, the percentages were 51.1% before and 38.9% after.

6.2.1 Percentage Speed Compliance Among Cars and Trucks (Before and After)

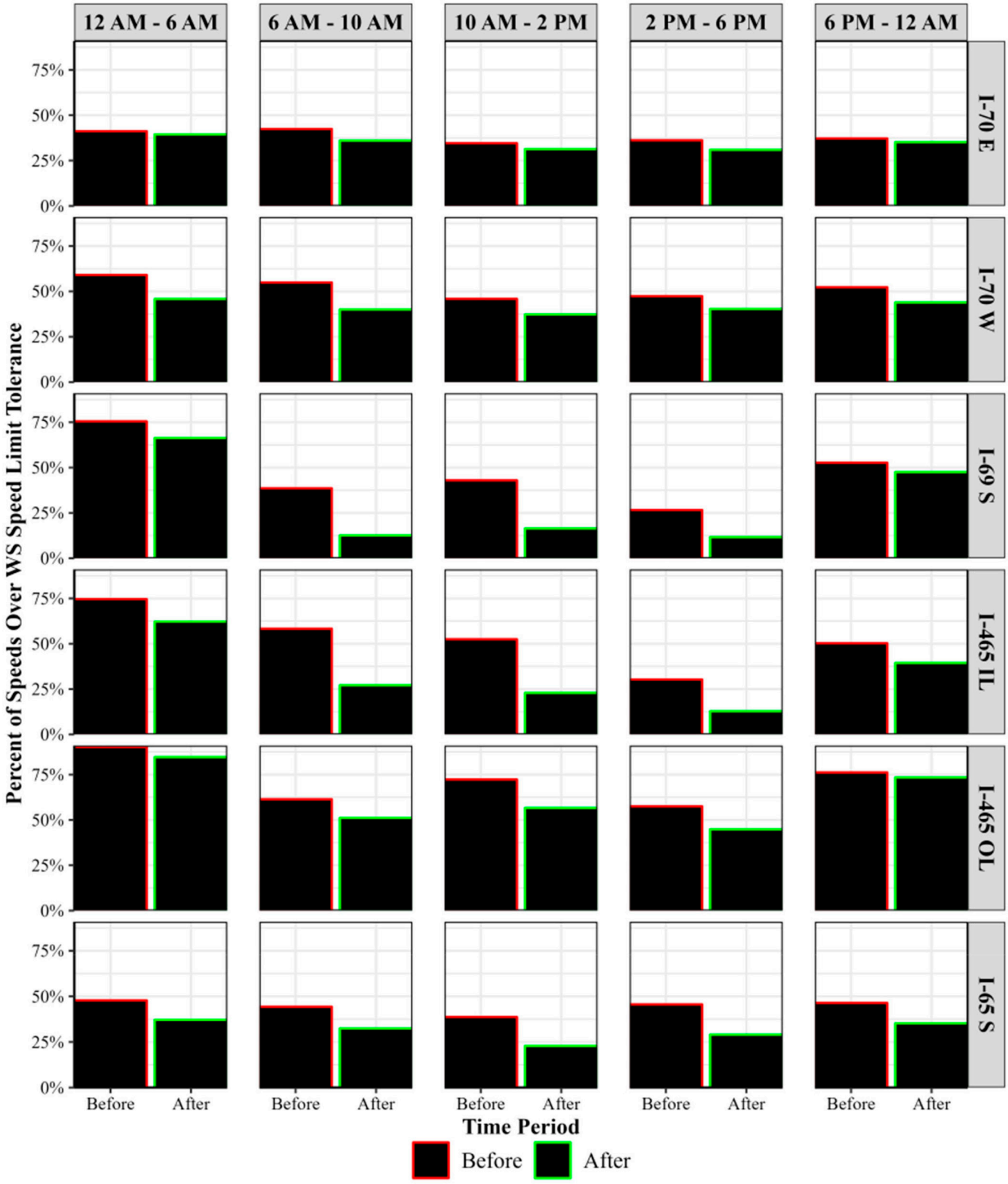


Figure 6.8 Percent of Passenger Vehicle Speeds Over WS Speed Limit Tolerance for Entire WS (Weekdays).

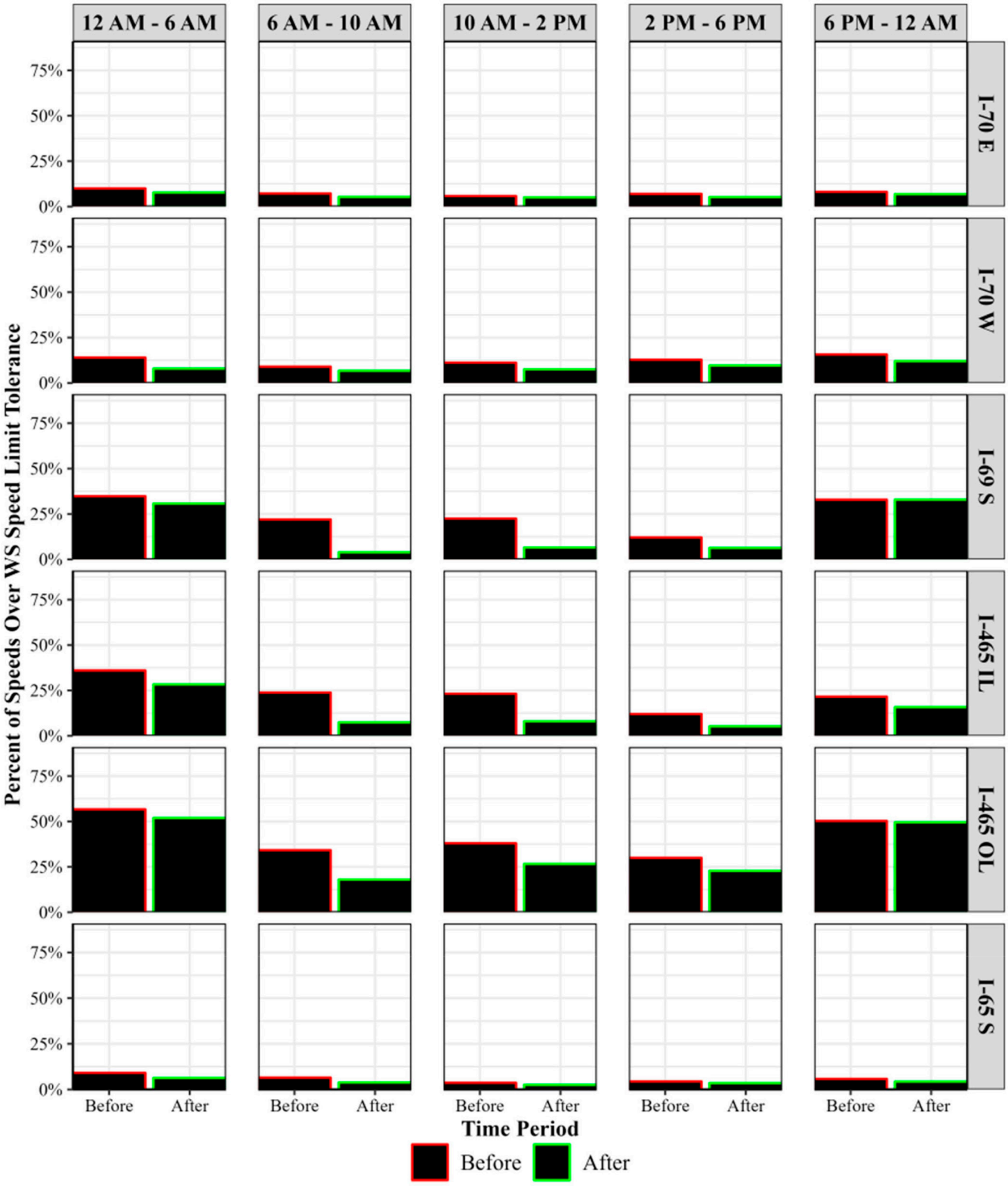


Figure 6.9 Percent of Commercial Truck Speeds Over WS Speed Limit Tolerance for Entire WS (Weekdays).

6.2.2 Percentage Change in Percentage Speed Compliance Among Cars and Trucks (Before and After)

Table 6.1 and Table 6.2, respectively, present summary statistics on the percentage change in the percentage of speeds 11 mph or more over the WS speed limit on weekdays for passenger cars and commercial trucks shown in Figure 6.8 and Figure 6.9. The first column in each table lists the different worksites and direction of travel analyzed along with the period of analysis. The final column lists the number of unique days where active SSC was present on each worksite. The I-70 worksite witnessed 78 days of active SSC in the Fall of 2024. I-69 and I-465 both observed more than 90 days of active SSC in the first half of 2025.

Even though none of the SSC deployments were in either of the 12:00–6:00 a.m. or 6:00 p.m.–12:00 a.m. time periods, there is still an observable impact and reduction in percentage of speed records 11 mph or more than the WS speed limit in those time periods. This illustrates the residual impacts of SSC activity even outside of active SSC times. For passenger vehicles, every single time period and worksite combination see a reduction in the percentage of speed records 11 mph or more than the WS speed limit on days with active SSC (Table 6.1).

7. CONCLUSION

Indiana deployed SSCs on four interstate construction zones and on approximately 443 deployment days over the past 13 months. To quantify the impact of this deployment, approximately 104 million passenger vehicle records and 3 million commercial truck records corresponding to these construction zones were analyzed. That connected vehicle data was used to count the number of spot speeds, linearly referenced to 0.1-mi intervals, that were 11mph or more over the worksite speed limit over the entire worksite. The length of those worksite study segments ranged from 3–10 mi, with sites spread across three counties: Marion, Hancock, and Lake.

Across 443 SSC deployment days between August 14, 2024, and July 11, 2025, the study found:

- Speed compliance gradually increased longitudinally from the location of the first fixed advanced warning sign to the SSC unit's location. This documents the impact of advance warning signs on speed reduction.
- The analysis found a 34% reduction on average in the percentage of passenger vehicle speeds exceeding the worksite speed limit by 11 mph or more on weekdays between 6:00 a.m.–6:00 p.m. (Table 6.1).
- For commercial trucks, there was a 41% reduction on average between 6:00 a.m.–6:00 p.m. across the four study sites (Table 6.2).
- There were no deployments on any of the worksites from 12:00–6:00 a.m. or from 6:00 p.m.–12:00 a.m. Even so, there are clearly substantive impacts on the speeds even in periods where there is no visible SSC. For example, when looking at the I-465 Inner Loop, the 10:00 a.m.–2:00 p.m. time period observed 56% to 66% reductions in the percentage of speeds 11 mph or more than the WS speed limit for passenger vehicles and commercial trucks, respectively; the 6:00 p.m.–12:00 a.m. hours still witnessed a 22% to 27% reduction in the percentage of speeds 11 mph or more than the WS speed limit (Table 6.1 and Table 6.2).

TABLE 6.1
Percentage Change in Passenger Vehicle Speeds Over WS Speed Limit Tolerance (Weekdays).

Route	Analysis Period	12:00–6:00 a.m.	6:00–10:00 a.m.	10:00 a.m.–2:00 p.m.	2:00–6:00 p.m.	6:00 p.m.–12:00 a.m.	Days with Active SSC
I-70 EB	Jul. 22–Dec. 22, 2024	-4.5	-15.1	-9.6	-14.7	-5.5	78
I-70 WB	Jul. 22–Dec. 22, 2024	-22.4	-26.8	-18.5	-14.4	-16.1	77
I-69 SB	Dec. 9, 2024–Jul. 13, 2025	-12.1	-67.4	-61.8	-56.3	-9.9	98
I-465 IL	Dec. 9, 2024–Jul. 13, 2025	-16.7	-53.5	-56.3	-57.7	-21.6	93
I-465 OL	Dec. 9, 2024–Jul. 13, 2025	-6.2	-16.7	-21.8	-22.2	-3.7	92
I-65 SB	Apr. 28– Jul. 13, 2025	-22.5	-26.8	-41.1	-36.5	-24.1	5

TABLE 6.2
Percentage Change in Commercial Truck Speeds Over WS Speed Limit Tolerance (Weekdays).

Route	Analysis Period	12:00–6:00 a.m.	6:00–10:00 a.m.	10:00 a.m.–2:00 p.m.	2:00–6:00 p.m.	6:00 p.m.–12:00 a.m.	Days with Active SSC
I-70 EB	Jul. 22–Dec. 22, 2024	-23.2	-26.7	-14.4	-26.5	-16.5	78
I-70 WB	Jul. 22–Dec. 22, 2024	-42.4	-24.9	-32.6	-23.5	-21.8	77
I-69 SB	Dec. 9, 2024–Jul. 13, 2025	-11.8	-82.4	-71.0	-48.2	0.1	98
I-465 IL	Dec. 9, 2024–Jul. 13, 2025	-21.4	-69.1	-65.6	-56.6	-27.0	93
I-465 OL	Dec. 9, 2024–Jul. 13, 2025	-8.5	-47.3	-30.1	-24.1	-1.6	92
I-65 SB	Apr. 28,–Jul. 13, 2025	-30.6	-41.7	-32.3	-20.5	-26.1	5

- In addition to this temporal spillover, the study also found spatial spillover impacts of the SSC unit at reducing speeds across the worksite and not just at the SSC location (Figure 5.2 and Figure 6.7).
- There is a modest rebound in speeds on the weekend when there are no SSC deployments for 2–3 days (Figure 6.1, Callout ii and Figure 6.7, Callout ii). When there is a sustained period of no SSC deployments, there is a rebound in traffic speeds (Figure 6.1, Callout iii).
- There was a significant increase in speed reductions when the pilot program moved from a pre-enforcement period to mailing warnings over the course of the past 13 months as evidenced by the increasing percentage reductions seen in Table 6.1 and Table 6.2 from the I-70 EB worksite to the most recent I-65 SB worksite.

The analysis presented by this study provides practitioners with a scalable methodology and reporting framework to quantitatively and systematically evaluate the effectiveness of their SSC deployments with widely available CV data.

8. FUTURE RESEARCH

While this particular evaluation was solely focused on documenting changes in speed compliance trends, future evaluations may incorporate enhanced safety datasets such as hard-braking and hard-acceleration events to also evaluate changes in safety performance with active SSCs.

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APPENDICES

Appendix A. List of Acronyms

Appendix A. List of Acronyms

CV	Connected Vehicle
DL	Deployment Logs
EB	Eastbound
DOT	Department of Transportation
FHWA	Federal Highway Administration
IL	Inner Loop
INDOT	Indiana Department of Transportation
MM	Mile Marker
OL	Outer Loop
SB	Southbound
SSC	Speed Safety Camera
WB	Westbound
WS	Worksite
WSCS	Worksite Speed Control System

About the Joint Transportation Research Program (JTRP)

On March 11, 1937, the Indiana Legislature passed an act which authorized the Indiana State Highway Commission to cooperate with and assist Purdue University in developing the best methods of improving and maintaining the highways of the state and the respective counties thereof. That collaborative effort was called the Joint Highway Research Project (JHRP). In 1997 the collaborative venture was renamed as the Joint Transportation Research Program (JTRP) to reflect the state and national efforts to integrate the management and operation of various transportation modes.

The first studies of JHRP were concerned with Test Road No. 1—evaluation of the weathering characteristics of stabilized materials. After World War II, the JHRP program grew substantially and was regularly producing technical reports. Over 1,600 technical reports are now available, published as part of the JHRP and subsequently JTRP collaborative venture between Purdue University and what is now the Indiana Department of Transportation.

Free online access to all reports is provided through a unique collaboration between JTRP and Purdue Libraries. These are available at docs.lib.purdue.edu/jtrp/.

Further information about JTRP and its current research program is available at engineering.purdue.edu/JTRP.

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Desai, J. C., Sakhare, R. S., McGregor, J., Sturdevant, J., & Bullock, D. M. (2025). *Worksite speed control system (WSCS)* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2025/33). West Lafayette, IN: Purdue University. https://doi.org/10.5703/1288284318595