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Examination of Three Districts Implementing Stop-Arm Camera Programs to Enforce Laws Against Illegal Passing of Stopped School Buses

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16 Abstract School bus stop-arm cameras are an emerging strategy used by school jurisdictions and law enforcement agencies to address the issue of drivers illegally passing stopped school buses. A stop-arm camera typically records video of vehicles and/or drivers who pass school buses when the stop-arm is extended. Several States have passed legislation allowing the use of stop-arm cameras on school buses and others have indicated they plan to propose similar legislation. The current study included: (1) a literature review of implementations around the United States; (2) a detailed examination of stop-arm camera implementation in three school districts (Arlington Public Schools, VA; Bellevue Public Schools, NE; and Rankin County School District, MS); and (3) an analysis of previously collected camera-enforcement data from an additional 33 districts obtained from a camera vendor. The three districts that participated in the study provided information about their experiences in implementing photo enforcement. They offered: (1) their experiences with legislation; (2) reactions and experiences of their bus drivers; (3) efforts to educate and inform the public; (4) cooperation with law enforcement; (5) successes and challenges in issuing citations and penalties; and (6) lessons learned. Overall, the number of illegal passes reported in the three study sites was much higher when captured by stop-arm cameras as opposed to detailed paper forms completed by bus drivers, but the number of violations captured by stop-arm cameras was less than the number of violators noted during jurisdiction-wide, one-day paper surveys conducted in these districts. In addition, in these three districts, the number of illegal passes reported was much higher (at least 35 times higher) when reported by camera-equipped buses versus officer-observed passes. Stakeholder feedback from the three districts was used to assess the effect of stop-arm cameras on illegal school bus passing and to understand common issues or concerns with programs. While public support for photo enforcement varied widely, bus drivers were generally in support of the cameras. Stakeholder feedback emphasized the importance of districts considering photo enforcement to review information from and in consult with districts with existing programs.					
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Executive Summary

School bus stop-arm cameras are an emerging strategy used by school jurisdictions and law enforcement agencies to address drivers illegally passing stopped school buses. The stop-arm camera typically records video of vehicles and/or drivers who pass school buses when the stop-arm is extended. Several States have passed legislation allowing the use of stop-arm cameras on school buses and more States indicated plans to propose similar legislation.

The current study included a literature review and a detailed examination of stop-arm camera implementation in three school districts. Arlington Public Schools (APS) in Virginia, Bellevue Public Schools (BPS) in Nebraska, and Rankin County School District (RCSD) in Mississippi participated by providing information about their experiences in implementing photo enforcement. They offered their:

- experiences with legislation,
- reactions and experiences of their bus drivers,
- efforts to educate and inform the public,
- cooperation with law enforcement,
- successes and challenges in issuing citations and penalties, and
- lessons learned.

This study also analyzed camera-vendor-supplied citation data previously gathered from an additional 33 districts.

Findings from the literature review indicated that there have been successful implementations around the United States and that planning and implementation of new systems can benefit from the experiences of existing programs. Key strategies included:

- effective development of enforceable legislation;
- close coordination with school districts, the judicial system, and law enforcement;
- the careful selection of technology and vendors able to record violations according to appropriate legislation;
- implementation of a pilot program prior to active enforcement;
- and the development of a public awareness campaign so that the general public understands both laws as well as safety reasons behind them.

The three participating school districts implemented programs which phased in use of stop-arm cameras to report and deliver citations to drivers who illegally pass school buses. Each program consisted of up to three phases. During the pre-implementation phase, illegal school bus passes were identified, but drivers did not receive citations or notices. A baseline rate of illegal passing was established during this phase. During the warning phase, offending drivers received written warnings notifying them of their recent illegal school bus pass. These warnings were replaced with citations during the post-implementation phase. These programs, however, were not implemented consistently. For example, it was decided in Bellevue to issue citations only for repeat offenders.

Overall, the study showed that the number of illegal passes reported was much higher when reported by stop-arm cameras as opposed to paper forms completed regularly by bus drivers; however, the number of violators reported by stop-arm cameras was fewer than the number of violators captured during district wide one day bus driver surveys. In addition, the number of illegal passes reported was at least 35 times higher when reported by camera-equipped buses versus officer observed passes.

There were no significant decreases in the number of violators after the implementation of stop-arm cameras. This finding was consistent across bus driver collected survey data and camera recorded violations. Analysis of vendor data obtained from 34 jurisdictions found decreases in the number of violators in some jurisdictions after implementation, while not in others. After drivers receive a citation, they do not appear to receive additional citations. In Arlington, there was only one repeat citation out of

1,089. In Bellevue, the recidivism rate was between 3% and 10% each year; however, Bellevue provides only warnings for all first-time offenders, not citations. Across camera vendor data for 34 jurisdictions, the percentage of repeat violators never exceeded 3% for any jurisdiction, and of 139,913 illegal passes recorded, only 2,447 or 1.87% were repeat offenders.

Stakeholder feedback was used to assess the effect of stop-arm cameras on illegal school bus passing and to understand issues with the programs. The research team conducted interviews with each district's transportation director, several law enforcement officers, and bus drivers. The interviewees relayed that public support for photo enforcement varied widely. In areas with strong public support, concerns about existing programs consisted mostly of strong requests from parents for a camera-equipped bus on their child's route. When opposition was present, privacy issues tended to be the central issue. Some people expressed concerns over the use of photographs of vehicles and drivers. Others had objections to "Big Brother"-type surveillance. In some jurisdictions, enforcement was viewed as a revenue generator rather than a safety measure. Transportation directors said that when strongly expressed, opposition can affect legislative efforts to allow photo enforcement.

Some districts benefited from the experiences of others. Particularly when a program existed within a State already, an experienced district could provide important information to a district that was considering adding photo enforcement. This assistance included documents such as a memorandum of understanding with law enforcement to allow review of photographs, advice on key players to engage, an overview of the sequence of the process, strategies for engaging the public, challenges and hurdles faced, and pitfalls to avoid.

Bus drivers generally supported the cameras. In districts where not all buses are equipped with cameras, drivers requested camera-equipped buses. Bus drivers said they wanted the photo enforcement to be successful: they wanted illegally passing drivers to be cited. When bus drivers voiced concern about the cameras, it was because the bus drivers could not tell whether an illegally passing driver would be ticketed as the bus driver was removed from the process of issuing the citation. Bus drivers said they were less concerned with punishment for the violating drivers and more concerned with preventing future passes.

In a State that required license plates only on the rear of vehicles, photos occasionally did not adequately capture the illegally passing license plate at certain angles. In a small number of cases, other issues also occurred (for example, photos at night were occasionally affected by headlight glare). However, overall, school districts expressed satisfaction with the mechanical functioning of the photo enforcement equipment. Camera systems activated as expected, captured the views of passing vehicles, captured time/date/location tags, and stored the information with reasonable reliability.

1. Background

Traveling by school bus is the safest mode for transporting pupils to school (NHTSA, 2020). Based on the 2017 National Household Travel Survey, about 20 million children ages 5 to 14 must travel over 2 miles to school, with 50% of these students riding the bus (Bureau of Transportation Statistics, 2021). Household income and vehicle ownership influence school bus use. Low-income family students are more likely to ride a school bus than non-low-income family students (60% versus 45%). In addition, although 80% of low-income families and over 99% of non-low-income families own at least one vehicle, children from low-income families with at least one vehicle are more likely to ride a school bus than their counterparts from non-low-income families with at least one vehicle (60% versus <50%). Again, while school buses are the safest way to get to school, data indicate that more school-age pedestrians are killed during the times when buses are typically loading and unloading passengers than any other hours of the day, with one-third of these fatalities being caused by vehicles other than the school bus (NCSA, 2018).

Figure 1. School Bus With Extended Stop-Arm Bar



School buses are equipped with devices to alert drivers that school children are being picked up or dropped off. One of these devices is a stop-arm bar. When activated, a flashing stop sign attached to a bar on the left side (driver’s side) of the bus extends perpendicular to the traffic flow so that it is visible to drivers approaching from either direction. While the methods of enforcement of school bus stop laws varies between States, all drivers must treat these stop signs as authoritative, traditional stop signs.

Children crossing streets are especially vulnerable. Their safety is reduced when drivers disregard school bus stop signs. A survey based on a sample from 39 States with 130,963 bus drivers, reported that in 2019 on a single Spring day 95,319 vehicles illegally passed stopped school buses (National Association of State Directors of Pupil Transportation Services, 2019). If the data are extrapolated over an entire 180-day school year for all buses, there would have been more than 17 million motorist violations. Such violations can result in near misses, injury, or in some cases student fatalities.

All States have variations of requirements to stop when a school is stopped with the stop-arm bar and/or flashing red lights activated (School Training Solutions, n.d.). The school bus stop-arm camera is an emerging strategy to address the issue of drivers illegally passing stopped school buses. The camera records video of vehicles and/or drivers who pass school buses when the stop-arm is extended. All offending vehicles are captured on video for review of the possible violation and issuance of a citation. The review and issuance of citations should be applied even-handedly. At least 21 States have passed legislation allowing the use of stop-arm cameras on school buses and more have indicated that they plan to propose similar legislation (National Conference of State Legislatures, 2020). The States that have passed legislation allowing the use of stop-arm cameras and/or related to automated school bus stop-arm enforcement include Alabama, Arkansas, Connecticut, Georgia, Idaho, Illinois, Indiana, Maine, Maryland, Mississippi, New York, North Carolina, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Utah, Virginia, Washington, West Virginia, and Wyoming.

2. Objective

The overall objective of the study was to determine the extent to which drivers do not stop for school buses loading and unloading students before and after implementation of a stop-arm bar camera enforcement program. To help answer this objective, the project was comprised of three main components: (1) a literature review, (2) an examination of three localities implementing a camera program, and (3) an analysis of existing vendor supplied camera data. The literature review described the state-of-practice regarding stop-arm enforcement legislation and practices throughout the country. The findings identified potential school systems for participation in the detailed examination of districts implementing a camera program. The three localities provided information about their experiences in implementing photo enforcement including citation data, experiences with legislation, reactions and experiences of their bus drivers, their efforts to educate and inform the public, their cooperation with law enforcement, their successes and challenges in issuing citations and penalties, and lessons learned. This study also analyzed camera vendor supplied citation data previously gathered from an additional 33 districts.

3. Literature Review

The literature review described the state-of-practice regarding stop-arm enforcement legislation and practices throughout the country. Information was collected about States and localities that either have existing legislation or were considering legislation regarding automated school bus stop-arm enforcement. Specifically, this section summarizes findings in the following areas:

- Existing programs review;
- Pilot programs;
- Stop-arm initiatives under development or consideration;
- Jurisdictions that decided against a stop-arm camera program;
- Legislation regarding automated enforcement of stop-arm violations;
- Public awareness campaigns; and
- Training materials related to automated enforcement procedures (including but not limited to stop-arm cameras, speed enforcement cameras, and red-light cameras).

3.1 Existing Programs Review

Stop-arm cameras have been used since 2011 as an enforcement technique to target drivers illegally passing a stopped school bus. The review identified elements to be considered at both the State and local levels for program implementation, including the evidence required to issue a citation and the penalties that can be imposed. Localities must determine the citation process, including who reviews the video surveillance, who issues citations, and the fine amount if this is not already determined by the State.

3.1.1 What Evidence Is Required for a Conviction?

Two prevailing methods were found to be in use by jurisdictions to identify violators from stop-arm cameras: facial recognition and license plate recognition. The selected method depends on the specific requirements provided in the State or local legislation. Many States and jurisdictions require a video clip of the illegal maneuver and a clear image of the license plate. In Georgia, the City of Decatur, Douglas County, and Clarke County all capture a video clip of the incident and an image of the violating vehicle's license plate (School Bus Fleet, 2014b; Douglas County School System, 2018; Johnson, 2014). Georgetown, Texas, uses stop-arm cameras to record the vehicle's license plate and video of the illegal maneuver. The information is automatically uploaded to a database system that is shared or sent to local law enforcement for review (Beausoleil, 2014). Alabama, Connecticut, Georgia, Illinois, Rhode Island, Utah, and Washington also include privacy safeguards such as requiring that images are not public record, that images must be destroyed within a certain amount of time, and/or that images cannot contain the face of driver or passengers (NCSL, 2020).

North Carolina requires the vehicle's make and model, an image of the license plate, and digitally recorded images of the offending driver (Cook & Tsai, 2013). A representative of the Fort Mill, South Carolina, School District's transportation department provided this rationale for the type of legal statute: "we can't ticket a car – [we] have to ticket a person." He explained that technology allows stop-arm enforcement through digital recording. "Before now, the cameras haven't been good enough to capture the [driver's] face." He further explained that this method of enforcement is now more viable because cameras have enhanced facial-recognition abilities (White, 2015).

Dallas County Schools, an educational agency that provided services to schools in the Dallas, Texas, area through July 2018, provided and operated its own stop-arm cameras. Video recording captured the violator's license plate, then law enforcement reviewed the videos, and motorists who were found breaking the law were retroactively mailed a ticket (Carrollton [Texas] Police Department, 2014). The use of high-quality digital cameras that can identify and record faces raises privacy issues for many people. The fact that the local police were reviewing the footage and delivering the tickets, rather than

the private companies, likely makes the general public more accepting of this technology. Following a public vote, DCS dissolved in July 2018 amid allegations of corruption and financial mismanagement (Friedman, 2018). The buses that were operated by DCS were to be split among the school districts that used DCS, including Dallas Independent School District.

3.1.2 Methods of Data Collection Recording

In practice, recording video is the prevailing method of automated stop-arm enforcement. Most often, still images are clipped from digital videos and used in identification. Although a still picture is typically used as evidence of violations, recording the violations in the field with video, rather than pictures, ensures there will be several images available to provide clear identification of the driver and vehicle.

In Stratford, Connecticut, the cameras mounted on school buses automatically begin recording video when the bus stops and the stop-arm extends. The system sends the video to the Stratford Police who review the footage and produce an official affidavit for enforceable violations. The affidavit describes the incident and includes a still picture taken from the stop-arm camera's video. This affidavit, along with an Internet link to the video, is sent to the owner of the vehicle by mail (Reilly, 2013).

Many localities operate with a system similar to the system used in Clarke County, Georgia. Cameras activate when the bus stop-arm extends and capture video footage of traffic approaching from either direction. The camera vendor reviews the videos, eliminates non-violators, and sends the videos to local law enforcement for further review (Johnson, 2014). This type of system has been used by:

- Decatur, Georgia (School Bus Fleet, 2014b);
- Douglas County, Georgia (Douglas County School System, 2018);
- Newton County, Georgia (Robins, 2014);
- Georgetown, Texas (Beausoleil, 2014);
- Pierce County, Washington (Small, 2014);
- Henry County, Georgia (Jackson, 2012);
- Prince George's County, Virginia, and 18 other Virginia school districts (Speer, 2014a).

Additionally, Fort Mill, South Carolina, uses digital camera footage as a large part of investigations and as evidence in court (White, 2015).

3.1.3 Fines and Other Legal Penalties/Consequences

The consequences for a school bus stop-arm violation vary based on local laws. These may include initial warnings, fines per violation, or even jail time. Not only do the consequences vary widely from location to location, but consequences are also subject to change as school bus stop-arm technology is installed in more jurisdictions and as drivers become more aware of their local school bus stop-arm law.

Flat Fee System –In Washington State, citations issued with automated camera systems incur a \$419 fine, but are processed in the same manner as parking citations that do not become documented on a driver's permanent record (Cornwell, 2017).

Tiered Fee System – Many jurisdictions use a tiered system with increasing severity of legal consequences based on violator frequency or severity of the violation. (Recidivism in the current study is discussed further in Sections 4.5.4 and 5.2.) Georgia uses a tiered system to discourage repeat offenders. A Georgia driver's first citation for a school bus stop-arm violation results in a fine of \$300, a second violation results in a \$750 fine, and finally \$1,000 for that driver's third violation in a 5-year period (School Bus Fleet, 2014b; Johnson, 2014; Douglas County School System, 2018; Clayton County Public Schools, 2013). In addition, six points are added on the driver's license for each violation (McMahon, 2014). School bus stop-arm violations are tied (with aggressive driving and speeding at 34 mph or more above the posted speed limit) for the highest number of points per violation in Georgia.

North Carolina also uses a tiered penalty system. Their tiered system is based on the escalation of crash severity. Failing to yield to a school bus stop-arm is a \$500 minimum fine and is also considered a Class 1 misdemeanor. The penalty for violators who strike a person results in a minimum fine of \$1,250. At the third tier, if the pedestrian is killed, the minimum fine to the driver is \$2,500 (Cook & Tsai, 2013).

A tiered system is used in Fort Mill, South Carolina, as well. A violator's first conviction results in a minimum fine of \$500 along with six points added to the driver's license. For the second violation, and any other violation, the fee quadruples to \$2,000 (White, 2015).

Georgetown, Texas, is another locality that uses a tiered system. If a driver is cited in a 36-month period for passing a stopped school bus with its stop-arm activated, the fine is \$300 for the first citation, \$600 for the second, and \$900 for the third (Beausoleil, 2014).

These examples highlight the variability in legal consequences across jurisdictions in the United States. Widespread enforcement of the stop-arm law (a law which varies by State) has only become possible in the last 10 years as a result of improved camera technology. However, there is no standardized fine or consequence applied across the country, and great variations exist in enforcement.

In Frederick County, Maryland, passing a school bus with its stop-arm extended carries a penalty of \$125" (Jones, 2014). In Montgomery County, Maryland, a suburb of Washington, DC, the \$125 fine was doubled to \$250 (Montgomery County, 2018). An increase in fines is likely to occur in other localities as camera technology improves and makes penalizing the violation easier and elevates the priority status of passing a school bus as a safety hazard.

3.1.4 Effectiveness: Number of Violations Flagged Versus Citations Issued

Many jurisdictions have captured a high frequency of violations since implementing stop-arm camera programs. For example, 216 violations were recorded on five buses in a period of 32 days during a pilot study in Chesterfield County, Virginia (Sears, 2014). In Douglas County, Georgia, 275 citations were issued in 128 school days (equating to an average of 2.15 citations per day).

Data is lacking on the long-term effect of the cameras. Though several programs have been successful in identifying violations, the effectiveness of the cameras in reducing stop-arm violations and improving student safety is yet to be demonstrated. Most enforcement programs in the U.S. are relatively new, but jurisdictions that have had cameras in place for longer periods of time are able to provide some insight on the long-term effectiveness of the cameras. For example, Muscogee County, Georgia, claims that the number of violations has decreased by 50% since the implementation of 50 stop-arm cameras on its school buses, down from 300 violations in 2011 to 142 in 2012 (Hurst, 2013).

Coppell, Texas, reports that during a six-bus survey conducted in 2008, cameras "recorded at least one violation for each bus on every route and as many as 10 violations were detected during a single [route] trip" (Albanese, 2014). In 2014, Dallas County Schools, which operates the stop-arm cameras for the City of Coppell, reported that more than 100 violations were captured during the first three weeks of the 2013-2014 school year (Albanese, 2014).

Georgia's Marietta city schools reported that during a nationwide stop-arm violation count in 2012, organized by NASDPTS, there were 192 instances of illegal passing on a single day. In spring 2013 some 156 instances were reported. From October 2013 to May 2014, there were 830 stop-arm violation citations issued by the Marietta Police Department (McMahon, 2014). After the installation of 12 stop-arm cameras in October 2014, the total decreased to 112 incidents during a single day count, which amounted to a 42% decrease in one year.

Montgomery County, Maryland, which had 25 cameras installed on public school buses in 2014, reported that their cameras recorded 4,800 violations in the first 2.5 years. The program expanded, with 500 buses outfitted 34,778 citations were issued during the 2017-2018 school year (Montgomery County, 2018). As

of September 2019, all of the county's approximately 1,300 buses were equipped with cameras (Montgomery County, 2021).

According to one of the stop-arm camera providers, 99% of all drivers recorded by the vendor's cameras do not receive second citations (American Traffic Solutions, 2014). This suggests the effectiveness of camera systems at raising public awareness of stop-arm laws and reducing the number of repeat violators.

3.1.5 Challenges and Limitations

Despite the acknowledgement of safety benefits, there are challenges and limitations with implementation of stop-arm camera programs. One challenge is how citations are issued. In Rockingham County, Virginia, the vendor reportedly sent citations without human interaction, and without the mandated court date listed (Speer, 2014b). Less than a year later, the school district stopped using the cameras because of issues with the camera company and legal issues surrounding mailing citations (Munro, 2020). Additionally, in 2012 there was opposition in Gwinnett County, Georgia, to its stop-arm camera program after a vendor executive provided gifts and bribes to Government officials, and a former vendor chief executive officer was indicted on charges of collaborating to manipulate the red-light camera program (Gazaway, 2014).

In five North Carolina school districts, a pilot program funded by the North Carolina Governor's Highway Safety Office included the installation of stop-arm cameras between summer and fall 2011 (Cook & Tsai, 2013). From the 2011 implementation through September 2013, there were 77 violations recorded and prosecuted with no defense attorneys challenging the video evidence (Public Schools of North Carolina, 2014). Rowan County, one of the five districts in the program, flagged 32 violations during the 2011-2012 school year, "plus six incidents that were not recorded due to equipment problems" (Cook & Tsai, 2013). Though not cited frequently, equipment problems allow violations to become difficult to enforce. Of the flagged violations, 21 violators pled or were found guilty with the remaining 11 violations not prosecuted because of either being unable to identify the license tag or unable to confirm the license tag for the vehicle. The following school year, 35 violations were recorded with an additional 10 incidents not recorded as a result of equipment problems. Of these violations, 22 violators pled or were found guilty with the remaining violations not prosecuted due to being unable to identify the license tag, the driver, or having an incident judged as too close to call (Cook & Tsai, 2013).

In Dallas County, Texas, 5,742 of 8,436 appealed tickets were dismissed by city hearing officers between 2012 and 2014. This is a dismissal percentage of about 68%. Cases that were dismissed involved license plates that were inaccurately recorded (citing a vehicle which was not in the photograph), drivers being ticketed despite an inability to stop in time (the stop-arm extended at the exact same time the driver passed the bus), and even incorrect addresses listed in the citations. This causes people, who believe they are being systematically ticketed unfairly by cameras and enforcement software that do not function as designed, to oppose such enforcement practices and treatments. The Dallas County School District believed many of the dismissals were the result of hearing officers interpreting the laws differently from each other. County officials were working to address these issues with the system (Friedman, 2014).

Virginia faced legislation issues as additional school districts were exploring the use of cameras. For example, in October 2014 Fairfax County Public Schools in Virginia was investigating the pros and cons of a stop-arm camera program and planning to follow the example of Falls Church, Virginia. While Falls Church had only 12 buses, half of which are equipped with stop-arm cameras and Fairfax County Public Schools had more than 1,520 buses (Trompeter, 2014), Fairfax County was looking to the nearby program for precedent; however, as of October 2, 2014, Falls Church had not issued any citations because the State Attorney General has ruled that State law does not allow for citations to be sent through the mail, rather law enforcement officers must issue citations in person. Officials were hopeful to add new legislation that will allow them to reinstate the program (Smith, 2015). Effective July 1, 2019, all school districts in Virginia were given the opportunity to use cameras (Albemarle County Public Schools, 2019).

Wyoming mandated that every school district outfit buses with external stop-arm cameras by the end of the 2016-2017 school year, and yet Laramie County had issues initiating its program. Hurdles encountered included legislation, manpower, and money. Despite State legislation, a process at the local level still must be established. While the local law enforcement agencies were on board with the program, concerns existed regarding the financial and labor resources needed to make the program effective (M. Smith, personal communication, July 15, 2015).

3.2 Pilot Programs

The increasing number of school districts that are catching violations and subsequently issuing citations after implementing stop-arm camera programs, along with new legislation allowing for the use of such cameras, has inspired other school districts to follow suit. Many of these districts are implementing pilot programs to determine the effectiveness of the cameras to catch violations. Piloting a program typically involves installing cameras on a small number of buses. The cameras can either be rotated from bus to bus or be installed on buses that have routes where more violations are expected based on traffic volume and where more violations have been previously reported by bus drivers. As part of the pilot testing, school districts often include an initial phase when warnings are issued to raise driver awareness of the stop-arm camera program.

Legislation passed in 2014 in South Carolina allows automated enforcement of drivers illegally passing school buses. School districts were eager to put the cameras to use and three of the pilot programs in the State are described below.

- Lexington-Richland School District Five tested cameras and used several different models before deciding on a vendor (Ramsey, 2014).
- The Fort Mill School District planned a program to begin in October 2014 and purchased five portable cameras to be transferred from bus to bus (White, 2015).
- Anderson County School District Five tested cameras on five of its buses for three months during the 2013-2014 school year. During this period, 82 vehicles per month were caught illegally passing a stopped school bus (Brown & Freishtat, 2014).

School districts in other areas of the country have also tested camera systems. In Rolling Meadows, Illinois, five school buses were equipped with stop-arm cameras. As a part of their pilot program, violators were fined \$150 for a first violation and \$500 for subsequent violations. Initial revenue from tickets were planned to go first toward paying for the cameras. After that, the police department will receive \$30 per ticket as a processing fee and the remainder will be split evenly between the police, school district, and the vendor (Ho, 2014).

Jones County, Mississippi, piloted a stop-arm camera program that was inspired by Nathan's Law, which is named after a 5-year-old boy who was killed as the result of a stop-arm violation in 2009. As of February 2015, several buses were each outfitted with four cameras (Ciurczak, 2014; "Jones County school bus," 2015).

In Gwinnett County, Georgia, cameras were scheduled to be installed on buses beginning in fall 2013, but there was some opposition as a result of controversy surrounding the vendor, as mentioned previously in this report (Gazaway, 2014). According to the most recently identified report, 300 of 1,800 buses had been equipped with cameras, and approximately 7,400 violations were documented from January to the beginning of April 2015. An additional 70 cameras were scheduled to be operational by fall 2015 ("More stop-arm cameras," 2015).

In conjunction with pilot programs, many school districts and their corresponding jurisdictions are implementing educational programs to inform the public of stop-arm laws, the use of stop-arm cameras, and the consequences of illegally passing a school bus. For example, when Decatur, Georgia, began its stop-arm camera initiative in fall 2014, the city schools, police department, and camera vendor

collaborated to create a public service announcement (PSA) that explained how the stop-arm camera system works, the role of law enforcement, the penalties associated with stop-arm violation citations, and Georgia's laws regarding stopping for school buses (School Bus Fleet, 2014b). Similarly, in Kennebunk, Maine, two PSAs, one 30 seconds and one 60 seconds, were scheduled to air after the school board voted unanimously to accept a donation for the cameras. In that city, the cameras were approved following complaints of reckless driving around stopped school buses. According to the Kennebunk police chief, the PSAs were intended to show the public that officials take the complaints seriously (Acquisto, 2014).

3.3 Stop-Arm Initiatives Under Development or Consideration

While many programs have been initiated, several more are being planned and developed. For some, a pilot program has been completed and a formalized program is dependent on the school district and/or jurisdiction deciding whether to continue with more permanent implementation. For example, as of August 2014, the likely cause of delay in Rockingham County, Virginia, was controversy with the camera vendor. The county's transportation director did not provide details other than the district "wishes to step back and take a closer look at the program to see what our needs are and where we would like to go from here" (Speer, 2014c). In 2018, Rockingham County Public Schools indicated that their pilot program did not work out and they do not currently have stop-arm cameras on their buses.

It is more challenging to identify school districts that are considering implementing stop-arm camera programs. Typically, those considering a program are following examples of surrounding counties. In Iowa, some school districts are considering following the example of the Iowa City School District, who started their program in fall 2014; however, the success of Iowa City's program is yet to be determined. As of November 2014, Iowa's West Branch School District had one camera but was hoping to install more by the end of the school year. As of 2018, they had three buses with stop-arm cameras and as they order new buses they plan to order them with the cameras. Also in Iowa, the Muscatine School District was planning to implement a program by the 2015-2016 school year, pending approval. Previously, "the costs were too high for Muscatine based on the level of technology present" (Marks, 2014). The transportation department indicated at the beginning of the 2018-2019 school year that they have not implemented a program yet.

3.4 Jurisdictions That Decided Against a Stop-Arm Camera Program

Some jurisdictions decided against implementing a stop-arm camera program. Among the reasons for deciding against a stop-arm camera program are cost and determination that illegal passing of school buses is not a significant problem within the particular jurisdiction.

Due to cost concerns, some districts are equipping only a portion of their buses, and giving priority to those on high traffic and high incident locations or routes. Others, such as Cambridge, Minnesota, chose not to implement a program because of cost barriers and camera equipment corrosion from salt during winter. Cambridge's transportation director said funding would be used for other needs (Knutson, 2014).

Initially, the cost of the technology was the primary barrier for Muscatine County, Iowa. With the improvement of technology quality, the county is now considering implementing a program (Marks, 2014) because the fines collected from violations have the potential to offset most of the costs if the fine system and vendor agreement are structured advantageously. However, there remains a risk if a large number of citations are dismissed or the number of citations fails to meet expectations. In Dallas County, Texas, where 68% of tickets issued were dismissed, records show that in the first year, the school district received less than half of the expected revenue from fines (Friedman, 2014). While some tickets have the charge plead down, depending on the jurisdiction, tickets can be dismissed for a variety of reasons, including lack of evidence, the violation was committed by a different driver than the one cited, and prosecutorial discretion (Morelli, 2015).

Pilot observations using stop-arm cameras are often used to measure the number of illegal passings and help determine the extent of the problem before larger programs are launched. In some cases, illegal passing of school buses is not significant enough to justify a stop-arm camera program. Simsbury Public Schools in Connecticut operated a pilot program in fall 2013, as part of a grant. Only two violations were recorded, so it was decided not to continue with the program (“District’s stop-arm,” 2014a).

3.5 Legislation Regarding Automated Enforcement of Stop-Arm Violations

At least 21 States have explicit legislation related to the use of automated school bus stop-arm enforcement: Alabama, Arkansas, Connecticut, Georgia, Illinois, Indiana, Maine, Maryland, Mississippi, New York, North Carolina, Oklahoma, Pennsylvania, Rhode Island, South Carolina, Tennessee, Utah, Virginia, Washington, West Virginia, and Wyoming (NCSL, 2020). The details of the legislation vary from State to State; however, each law tends to address similar issues that include: who may implement the system; who may issue citations; what is required to warrant a citation; and how the fine revenue may be distributed.

3.5.1 Parties Involved in Automated Enforcement of Stop-Arm Violations

State versus Locality – Most States delegate the final decision-making process to localities, such as municipalities, school districts, and local boards of education. However, the State of Wyoming directed that by the 2016-2017 school year, each school bus used to transport students to and from school or to and from other student activities will have external video systems installed that are capable of automated enforcement. The costs associated with these systems were to be reimbursed by the State in accordance with other covered district transportation costs (Teigan, Shinkle, & Essex, 2015).

Law Enforcement Officers and the Judicial System – State legislation allows for localities to operate stop-arm cameras, but it is often left to the locality to establish a process for recording and issuing citations. Illinois, for example, authorizes each county or municipality to establish an ordinance for the implementation of a stop-arm camera program (NCSL, 2020).

Vendors – Some State laws specify whether localities are permitted to contract with private vendors to issue citations. If so, the legislation specifies to what extent these vendors may be involved in the automated enforcement process. For example, the State statutes in Rhode Island, Connecticut, and Illinois allow local agencies to contract with private vendors for system installation, operation, and maintenance while Washington State allows local agencies to use private vendors only for system installation and maintenance (NCSL, 2020).

3.5.2 Requirements to Issue Citations for School Bus Passing Violations

State laws may also govern the requirements for how to provide notice to the public, how to record violations, and how to issue citations.

Providing Notice to the Public – In Illinois, State law requires that municipalities, counties, and school districts provide public notice that automated enforcement is being used for illegal school bus passing maneuvers. Other States, such as Connecticut and Rhode Island, require warnings be posted on each bus that operates an automated enforcement camera (NCSL, 2020).

Recording a Violation – State laws frequently govern what is required to prove a violation and issue a citation. The following list includes common elements that must be present to prove that a violation occurred:

- Images or video clip of the motor vehicle and license plate;
- Images or video clip to identify the driver (prohibited in some States, required in others);
- Location of the event;
- Number and placement of cameras;

- Date and time of the violation; and
- Electronic symbols that indicate activation of the amber lights, flashing red lights, stop-arms, and brakes (Georgia and South Carolina).

Some States prohibit photographic evidence. Other States, such as Connecticut and Washington, specify that the images may not contain any identifiable images of the vehicle's occupants or surrounding traffic. Of the States that require driver identification, Georgia, Illinois, and Rhode Island specify that the images collected are confidential and not public record. Rhode Island law requires also that images and/or recorded video must be destroyed within 24 hours if a violation is not identified. If a violation occurred, the video may be maintained for up to one year before it is destroyed (NCSL, 2020).

Issuing a Citation – States vary regarding requirements to issue a citation, including any combination of the following: driver identification, license plate number, image of the vehicle passing the school bus with the stop sign extended, and indications of the status of the school bus (e.g., stop-arm extended, doors open, lights flashing).

In many cases, State laws require a law enforcement officer to review the evidence and issue the citation. For example, Rhode Island and Tennessee law enforcement officers are required to sign a written statement when they issue a citation for a violation that was captured with an automated enforcement system. Officers will dismiss violations that do not provide a clear case for issuing a citation.

Challenging a Citation – Of the States with automated school bus stop-arm enforcement, several of the State laws include the steps a driver or registered vehicle owner may use to challenge a citation. For example, in California and Georgia drivers can raise a legal defense on their own.

3.5.3 Camera Installation Costs, Revenue Generation, and Distribution

Stop-arm cameras are often installed by private transportation engineering companies. In some localities, the cameras are installed at no cost to the school system and the vendor receives a portion of each citation. In Pierce County, Washington, the vendor that provided the school bus stop-arm cameras gets \$69 of each \$419 fine (Cornwell, 2017). While the percentage may vary by locality, this concept is often what makes the cameras economically justifiable because there are no upfront costs to the school district, and it eliminates the risk of additional costs due to lack of funds generated from the program.

Some State laws include limitations to the minimum and maximum fines permitted for illegally passing a school bus with its stop-arm extended. Additionally, legislation may also contain requirements for distributing the revenue obtained through paid citations. States vary in distribution of funds but they are typically distributed among the State, municipalities, school districts, and vendors. Some States allow only reimbursement of direct vendor costs instead of allocating a set percentage of each fine to the vendor. States may also earmark funds for school transportation budgets, school zone improvements, school technology funds, or other educational programs.

3.5.4 Unsuccessful State Legislation

Nearly half of all States have considered legislation to allow automated stop-arm enforcement; however, not all States have successfully enacted a law. The most common characteristic of failed bills is that they do not require driver identification, and they hold the registered vehicle owner responsible for the violation. In several cases, the bills prohibited driver identification due to privacy concerns, but failed because the adjudication frequency would be too high as there would be no evidence of who was driving (NCSL, 2020). Even though it is a line of reasoning for a bill not passing, the anticipated high rate of violations can be used as support for approving stop-arm cameras.

In Iowa a law permitted the Iowa Departments of Transportation, Public Service, and Education to conduct a study on school-bus-mounted cameras, and to consider the requirements for implementing that type of system. While this study was approved, subsequent legislation pertaining to automated stop-arm

enforcement was halted due to public opposition. Critics of the system claimed that it violated Iowa City's ban on "automatic traffic surveillance systems." Although the ban did not apply to "qualified traffic violations," an attorney said this did not include illegal passing maneuvers (Morelli, 2014).

3.5.5 Local Ordinances

Most State laws allow local school districts or municipalities to decide whether to implement stop-arm cameras. Some localities, such as Dallas City, Texas, and Jefferson Parish, Louisiana, implemented local ordinances despite lacking official State laws (Rosales, 2012; Waller, 2012).

The presence of a State law that enables automated stop-arm enforcement does not necessarily mean that a local ordinance is unnecessary. For example, Virginia allows localities to issue citations when vehicles are photographed illegally passing stopped school buses; however, Chesterfield County, Virginia, required passage of an ordinance to allow the citations to be issued within its district (Sears, 2014).

Arlington County, Virginia, has a briefing paper on automated school bus enforcement that can serve as an example for jurisdictions considering local ordinances (Arlington County Government, 2014). It summarizes the State law, provides a background on school bus safety technology and traditional enforcement efforts, and includes an introduction on automated enforcement with simple diagrams to explain the system. It also summarizes other elements that should be considered prior to passing an ordinance such as fines and consequences, distribution of the revenue, and the percentage of buses that will have cameras installed. It details expected effectiveness of the system and the process of identifying a violation and issuing a citation. It concludes with recommendations for implementation and a draft code for approval (Lazo, 2014). Although Arlington County passed a code, implementation of its stop-arm enforcement program was suspended because the Virginia attorney general ruled that there is no legislation at the State level to allow for citations to be sent through the mail. The program was later reinstated.

3.6 Public Awareness Campaigns

To increase stop-arm bar compliance, public awareness campaigns have been organized at national, State, and local levels. The campaigns are intended to educate the public about the laws related to school bus safety. Many of these campaigns are programmed in conjunction with National School Bus Safety Week. Other campaigns coincide with recently passed legislation or the beginning of new school bus safety programs. Law enforcement officials, school district employees, students, and other people who are passionate about school bus safety are often the advocates behind these campaigns.

3.6.1 National Level

At the national level, various associations involved in school transportation safety sponsor National School Bus Safety Week, which is held the third week of October each year. As part of this initiative, many schools encourage their students to participate in poster and speech contests. Promotional material is provided to school districts to implement their own campaigns. Vendors are also involved in educational efforts. For example, American Traffic Solutions wrote a report titled *How to Help Eliminate Dangers of Traveling to and From School (and Keep Kids Safe)* and created a PSA video using the same name. The report and PSA encourage stop-arm cameras by indicating decreases in violations, as well as stating that a high percentage of violators who receive a citation do not receive a second ticket when stop-arm camera programs are in place (School Bus Fleet, 2014b).

Love the Bus, a campaign by the American School Bus Council (ASBC), promotes school bus safety awareness and promotes appreciation of school bus drivers. Although the campaign is ongoing, the ASBC celebrates Love the Bus Month in February. ASBC provides educators with a toolkit with resources for implementing programs. The campaign encourages students to share stories about their bus drivers and to create Valentine's Day cards for them (American School Bus Council, n.d.).

While not designated campaigns, online videos from a variety of resources such as news websites, safety advocate websites, YouTube uploads, and blogs, show vehicles approaching dangerously close to children crossing the street when the bus's stop-arm and flashing lights are activated. These videos have been extensively viewed and serve as de facto PSAs. For instance, news reports bring awareness to the public, such as the Today Show's Rossen Reports (www.today.com/parents/new-technology-targets-drivers-who-pass-stopped-school-buses-2D80217961), which reported on the frequency of stop-arm violations. NHTSA also maintains bus safety campaign material on its Traffic Safety Marketing website (www.trafficsafetymarketing.gov/get-materials/school-bus-safety/evergreen-campaign-material).

3.6.2 State Level

Many States operate public awareness campaigns on school bus safety. Some use hashtags to appeal to social media users, such as North Carolina's #Brake4Buses campaign. As part of this campaign, NBC's Today Show journalists showed their support for school bus safety by recording video messages. Furthermore, TV channel WNCN in Raleigh created a PSA in partnership with the North Carolina Department of Public Instruction that highlights the responsibility of everyone, including students and parents, to ensure school bus safety. Television stations across the Nation pledged to air the PSA (Hudson, 2014). The North Carolina State Highway Patrol also promoted school bus safety through its annual *Operation Stop-Arm* program (WRAL, 2014).

The Arkansas Department of Education and the Arkansas Association of Pupil Transportation collaborated to sponsor a campaign titled "Be aware. U stay alert. So kids don't get hurt." to emphasize the importance of stopping for school buses loading and unloading students. The campaign provided sample awareness material (School Bus Fleet, 2014c).

Anderson County, South Carolina, had a *Stop-Arm Violation Education Enforcement (S.A.V.E.)* campaign. The campaign aimed to increase school bus stop safety within the State and encouraged other States to campaign against stop-arm violations. The *S.A.V.E.* campaign proposed financing stop-arm educational efforts using fines collected from stop-arm violations caught through video surveillance. Roher (2013) indicated that statewide educational efforts include the use of billboards and literature to driver education classes, and other methods to promote stopping when school buses load and unload.

Georgia dedicates a website, *Operation Stop-Arm*, operationstoparm.info/, to increase public awareness about school bus stop-arms. The website including the laws, videos and slideshows, and relevant links to additional information.

3.6.3 Local Level

Many local campaigns have been scheduled in conjunction with the start of stop-arm camera programs to educate people about the importance of stop-arm safety, as well as notify the public about the use of automated enforcement.

PSAs, signage on the roads or at schools, and safety curriculum for classroom education are ways local officials raise awareness. In Kennebunk, Maine, signage at schools was updated, and 30- and 60-second PSAs were aired on the town's public access channel and posted on the town hall website. In conjunction with the start of the public awareness campaign with American Traffic Solutions, Decatur, Georgia, produced a PSA that highlighted Georgia as leading the Nation in fatalities resulting from school bus stop-arm violations in 2011 (School Bus Fleet, 2014b).

Some local campaigns use creative ways to increase public awareness. In Marion, Ohio, the police chief rode on school buses to raise awareness (Bechtel, 2014). In Richmond County, North Carolina, law enforcement and high school students created a PSA (Richmond County Daily Journal, 2014). Law enforcement in Bloomington, Minnesota, organized a purely educational sting operation to raise awareness rather than issuing citations. During this effort, police were stationed at bus stops and targeted

any vehicle that illegally passed a school bus. In addition, local media informed people of the new bus cameras (Nolan, 2014). Cobb County, Georgia, coordinated its “Watch You Like a Hawk” campaign to raise awareness of the stop-arm cameras. The campaign featured a hawk, named Lt. Hawk, as the mascot who led the effort (Nolan, 2014).

3.6.4 Results of Public Awareness Campaigns

Public awareness campaigns may appear to be a sensible tool in conjunction with the initiation of stop-arm camera programs; however, there is no empirical evidence of the effectiveness of public awareness campaigns alone to reduce injuries.

3.7 Conclusion

Jurisdictions considering stop-arm cameras have many factors to consider. Cooperation between all stakeholders, including the school district and law enforcement, is important. As part of the initial process, agencies should identify and comply with all the relevant State laws and local ordinances, both of which can affect the fine structure, citation process, and vendor agreements, among other factors. As stop-arm camera programs are initiated, public campaigns may raise driver awareness about school bus safety and the new enforcement measure. Research is needed in the areas of system effectiveness, best practices in both system implementation and continued operations, and the roll of public awareness campaigns in deployment and effectiveness of the new safety system.

4. Examination of Three Stop-Arm Camera Programs

Following the literature review, this project examined stop-arm camera implementation in three school districts to determine the extent to which drivers do not stop for school buses before and after implementation of stop-arm bar cameras, and also to get a better understanding of the factors that may influence the implementation and effectiveness of such enforcement programs. The following sections describe the process used for identifying school districts, offer an overview of each program including timeline, and provide the data collection and analysis processes used to examine these programs.

4.1 School Selection Process

The research team worked with three school districts planning to install stop-arm cameras to cite drivers for failing to yield for stopped school buses. Jurisdictions with stop-arm camera programs and data were also identified. To select jurisdictions for stop-arm bar violation observations, the team talked with school systems planning to implement stop-arm camera programs to obtain additional information to determine applicability to the current study, and interest in participating in the project.

The following resources were used to identify school district contacts:

- Results of our literature review;
- National Association for Pupil Transportation (NAPT) Annual Summit;
- National Association of State Directors of Pupil Transportation Services (NASDPTS) Annual Conference;
- Stop-arm camera vendors;
- State directors in NASDPTS;
- Regional directors listed with the Virginia Association for Pupil Transportation (VAPT); and
- Websites of districts in States with approved legislation.

As part of site selection discussions, some school districts indicated that negative attention surrounding stop-arm enforcement programs in their State and/or issues with programs (either theirs or others') have made them leery of sharing data and potentially drawing attention to their program. Conversely, one transportation director in Wyoming indicated that, even though its program is reportedly one of the only successful programs in the State, the superintendent was not interested in releasing data. Other contacts expressed that they simply could not commit to the project because they were unsure about if and when their programs would begin, either due to funding constraints or pending necessary approvals and ordinances. Such concerns may explain the low response rate (~20%) among the initial contacts for possible inclusion in the study.

Three jurisdictions were selected to serve as primary sources of data for the study:

- Arlington Public Schools (APS), in Virginia, provided consolidated bus driver survey responses and high-level traffic court data resulting from passes observed by law enforcement officers.
- Bellevue Public Schools (BPS), in Nebraska, provided data on passes observed by bus drivers (recorded on paper forms) as well as on passes caught on camera.
- Rankin County School District (RCSD), in Mississippi, provided data from paper forms completed by bus drivers, as well as traffic court records. Two (of five) cities within Rankin County – Flowood and Richland – provided traffic court records.

Additional data was obtained from American Traffic Solutions, a camera vendor.

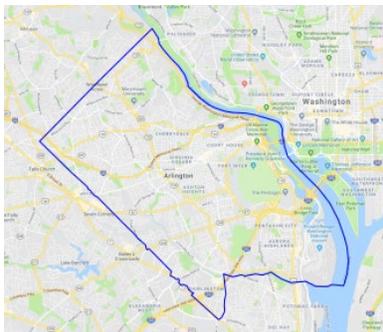
4.2 Composition Overview of the Jurisdictions

In the analysis of illegal school bus passes over time, rates were calculated per bus per school year. Table 1 shows the number of schools, students, buses, and students per bus in each jurisdiction. Each bus in Arlington, for example, carries an average of 154 students to and from school, with some buses covering multiple routes. In contrast, Rankin buses carry less than half as many students, but the school district itself covers 757 square miles. These statistics provide more context for the passes-per-bus-per-month metrics.

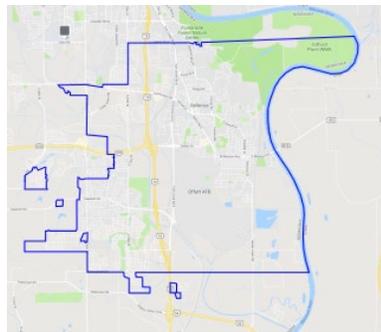
Table 1. Summary of Jurisdiction Size

Jurisdiction	Schools	Students	Buses	Average Number of Students per Bus	Size of School District (sq. miles)
Arlington	33	26,000	169	154	26
Bellevue	20	10,000	78	128	28
Rankin	28	20,000	280	71	757

*Figure 2. Reference Maps for Arlington, Bellevue, and Rankin Public School Districts
(Map Data: Google)*



*Arlington (Virginia)
Public Schools*



*Bellevue (Nebraska)
Public Schools*



*Rankin County (Mississippi)
School District*

4.3 Program Overviews

Arlington, Bellevue, and Rankin school districts provided information about their experiences in implementing photo enforcement. They offered their experiences with legislation, reactions and experiences of their bus drivers, their efforts to educate and inform the public, their cooperation with law enforcement, their successes and challenges in issuing citations and penalties, and their lessons learned.

4.3.1 Program Timelines

Arlington, Bellevue, and Rankin implemented programs to phase in the use of stop-arm cameras to report and deliver citations to drivers who illegally pass school buses. Each program consisted of up to three phases. During the pre-implementation phase, illegal school bus passes were identified, but drivers did not receive citations or notices. A baseline rate of illegal passing was established during this phase. During the warning phase, offending drivers received written warnings notifying them of their recent illegal school bus pass. These warnings were replaced with citations during the post-implementation phase. These programs, however, were not implemented consistently. For example, Bellevue decided to

issue citations only for repeat offenders. In Arlington, the initial post-implementation phase was interrupted due to legal issues. Table 2 summarizes the start dates of each phase in each jurisdiction.

Table 2. Start Dates for Each Program Phase by Jurisdiction

Jurisdiction	Pre-Implementation	Warning Phase	Post-Implementation
Arlington	May 7, 2015	July 8, 2015	October 3, 2016
Bellevue	March, 2014	August 2015	(None)
Rankin	February 2, 2016	March 1, 2016	April 1, 2016

4.3.2 Arlington (Virginia) Public Schools

APS serves approximately 26,000 school children in 33 schools, and had 169 school buses as of September 2017, with 19 equipped with exterior cameras for use in the stop-arm camera enforcement program.

APS adopted its stop-arm enforcement camera program after observing the experiences of a neighboring school district, Falls Church City Public Schools (FCCPS). FCCPS implemented its photo enforcement program for school bus stop-arm enforcement in 2013. APS administration monitored the program in FCCPS until 2015, when it contracted with the same vendor used by FCCPS to provide photo enforcement of illegal passing of stopped school buses. Table 3 provides a timeline of the Arlington program. Significant dates are listed but it is important to note that Arlington continues to run buses for various programs during the entire year, including summer months.

Cameras installed on the exterior of the bus are activated when the stop-arm is deployed and a passing vehicle is detected in the enforcement zone near the school bus. Video captures the illegal maneuver, the extended stop-arm, and the license plate of the vehicle. Wireless transmission sends the files to the vendor, who reviews the footage, confirms the violation, extracts images, and sends the data and video to local law enforcement. Law enforcement reviews the information, confirms the violation and approves or denies the citation. The vendor mails the citation to the vehicle owner’s address and includes still images. This process takes place quickly, within days. Video is available as further evidence when needed.

Table 3. Overview of Arlington’s Program Timeline

Program Phase	Date	Event
	September 23, 2014	APS School Board authorizes the schools to contract with an outside vendor to conduct photo enforcement
	September 24, 2014	APS School Board decision covered by Arlington Now (local news appearing in print and online)
Pre-Implementation	May 7, 2015	Data collection began
Warning	July 8, 2015	APS transportation director and ATS (camera vendor) hold a press conference to announce photo enforcement launch and warning period. Frequently Asked Questions (FAQ) page is provided at apsva.us
	July 9, 2015	APS/ATS press conference coverage includes Arlington Patch (local news in print and online)
	September 7, 2015	First day of 2015-2016 school year

Program Phase	Date	Event
		First day of active enforcement, \$250 fine
Suspension	September 12, 2015	Enforcement suspended due to legal issues
	October 23, 2015	Suspension of enforcement covered by <i>Washington Post</i>
	November 21, 2015	Suspension of enforcement covered by Zentinel (online trade news covering mobile surveillance issues)
	June 11, 2016	Expected resumption of enforcement covered by WTOP (broadcast and online)
	June 16, 2016	APS issues press release announcing resumption of stop-arm photo enforcement
	June 22-24, 2016	Last day of school
	September 6, 2016	First day of 2016-2017 school year
Post-Implementation	October 3, 2016	Enforcement reinstated with no warning period, \$250 fine Coverage by Fox5 news appeared on TV and online
	June 20-24, 2017	Last day 2016-2017 school year
	August 16, 2017	Photo enforcement effort is covered by WJLA and Arlington Now (local news appearing in print and online)
	August 29, 2017	Coverage of photo enforcement in Arlington Now (local news appearing in print and online)
	September 5, 2017	First day of 2017-2018 school year
	June 15-20, 2018	Last day of 2017-2018 school year

4.3.2.1 Legislation

Legislative efforts to allow photo enforcement encountered some obstacles. APS contracted with a vendor to install photo enforcement systems on 20 buses and began enforcement efforts in 2015 with a 30-day warning period and active enforcement to begin with the fall semester. However, Virginia law in 2015 did not adequately empower the mailing of citations to violators, and legal issues forced the suspension of enforcement 5 days after the end of the warning period. Following the Attorney General's interpretation of the law, no additional citations were mailed, enforcement was suspended, and previously issued citations were cancelled. Legislation was enacted in 2016 to allow mail delivery of citations (thus making photo enforcement possible), and APS resumed enforcement on October 3, 2016.

4.3.2.2 Bus Driver Forms

Prior to the initiation of photo enforcement, APS bus drivers who witnessed violations were to write down information regarding the illegal pass. However, there was no standard form for noting violations, nor any formal mechanism for transferring information to police for enforcement. With the advent of photo enforcement, the procedure for bus drivers to report illegal passes remained unchanged.

Bus drivers also reported illegal passes in a survey conducted periodically within the district. Drivers used a standard form to note the time of day, side of the bus where the vehicle performed the illegal pass, and the direction of the vehicle’s approach.

4.3.2.3 Media Campaigns

Arlington’s outreach began with a press conference on July 8, 2015. The APS transportation director appeared with a vendor representative to announce the launch of the photo enforcement program and to answer media questions. The event was covered by print and media outlets. A page on the APS website provided detailed information about the program. Enforcement with citations and attached fines began on the first day of the school year, September 7, 2015, was suspended 5 days later following the attorney general’s interpretation of the law. Enforcement resumed on October 3, 2016. The APS website continued to provide information about the program and when photo enforcement resumed, it was covered by several media outlets.

See Appendix A for samples of Arlington’s media coverage.

4.3.2.4 Warnings and Citations

The fine for illegally passing a school bus in Virginia is \$250. Enforcement using the stop-arm cameras with warnings began on August 7, 2015. Active enforcement with citations and fines began on the first day of school, September 7. On September 12, enforcement was suspended pending resolution of legal issues. Enforcement with citations and fines resumed on October 3, 2016.

4.3.3 Bellevue (Nebraska) Public Schools

BPS serves approximately 10,000 school children with 20 schools and has 78 school buses. As of September 2017, 12 buses were equipped with exterior cameras for stop-arm camera enforcement. Table 4 provides a timeline of the Bellevue program.

Table 4. Overview of Bellevue’s Program Timeline

Program Phase	Date	Event
Ongoing	2008-Present	Bus drivers complete forms when there is an illegal pass and information is recorded in an Excel spreadsheet
	2013	Incident occurs with a child nearly being struck during an illegal pass
	December 2013	BPS first talks with vendor about stop-arm camera solution
	February 2014	BPS and vendor formalize agreement
Pre-Implementation	March 2014	First buses equipped with stop-arm cameras; data collection began
	July 2015	Local television stations air segments about the stop-arm camera program during the evening news
	August 2015	Live, on-air news stories and local newspaper article about the program at the start of the 2015-2016 school year
	August 11, 2015	First day of 2015-2016 school year
Warnings	August 11, 2015	Warnings began

Program Phase	Date	Event
	August-September 2015	Additional online media/outreach (news articles online, Facebook posts, etc.)
	December 16, 2015	Additional online news article
	March 21-15, 2016	Spring Break (no school)
	May 20, 2016	Last day of 2015-2016 school year
	August 11, 2016	First Day of 2016-2017 school year
	August 11, 2016	Morning news story on local station (WOW-TV)
	May 24, 2017	Last day of 2016-2017 school year

In 2008 BPS began using forms completed by school bus drivers to document illegal passes of stopped school buses. These forms were reviewed by the BPS transportation director and the information recorded in an Excel spreadsheet. The forms were then forwarded to the police department. Historically, law enforcement officers would call or visit the violator, but did not issue citations since they did not witness the violation.

In 2013 an incident with a child nearly being struck during an illegal school bus pass served as the catalyst for identifying strategies to reduce these types of violations. As BPS worked with a vendor to install internal cameras on new buses, the vendor offered an external camera solution which was still in the testing phase. Subsequently, a mutually beneficial agreement was established between the vendor and BPS. The vendor installed stop-arm cameras on five new buses and provided the supporting software to BPS at no cost in exchange for allowing the vendor to use the buses for testing purposes. The only equipment cost to Bellevue was the installation of WiFi points throughout the transportation center's parking lot to download the video as buses returned from their routes. Once a bus gets in range, the video automatically downloads directly to the transportation director's computer. This hands-free system allows the drivers to focus solely on driving. A camera begins to record video when all the following conditions are met:

- School bus is at 0 mph;
- Red lights are activated; and
- Stop-arm is extended.

The software is designed to assign probability that a violation occurred and the event is flagged. Once the bus returns to the parking lot and the video is downloaded, the transportation director reviews the video that has been flagged. He sends the video to the police department. He also sends an e-mail notification to the police department. If law enforcement determines it is a violation, an officer will call or visit the driver to discuss the incident. Because of favorable media coverage, the transportation director asked the vendor to install external cameras on additional buses.

Before the program launched, the police chief and county attorney agreed videos could be used as evidence. Originally, written citations would be issued to violators; however, this position changed as the program was implemented and law enforcement officers elected to call or visit drivers caught on the cameras with the intent of issuing written citations for repeat offenders.

4.3.3.1 Legislation

Nebraska State law is silent on the use of cameras for the enforcement of illegal school bus passes.

4.3.3.2 Bus Driver Reports

All BPS bus drivers, both those with and without stop-arm cameras, complete a form for each violation. A violation is defined any vehicle passing the bus while the stop-arm is extended. The form is submitted to the transportation director at completion of the route.

4.3.3.3 Media Campaigns

Media campaigns are essential for raising awareness about dangers of passing a stopped school bus and the laws and penalties associated with illegal passing. Media can also be used to spread information about a camera enforcement program. In Bellevue, media outreach started with the police department. The police chief posted a message on Twitter about the use of cameras on buses to enforce illegal passing laws. In April of the 2014-2015 school year, four local television stations contacted BPS about airing segments on the stop-arm enforcement program. BPS determined it would be most effective to air a story just before the 2015-2016 school year started. In July 2015 the local ABC, NBC, and CBS television stations, as well as the local Bellevue newspaper, received information about the program. That same month, all the television stations aired segments during the local evening news. Stations followed with on-air stories at the beginning of the school year. The local newspaper also published an article on the program prior to the beginning of the 2015-2016 school year. See Appendix A for samples of Bellevue's media coverage.

4.3.3.4 Warnings and Citations

The fine for illegally passing a school bus in Nebraska is \$500, and three points on the driver's license. Enforcement using the stop-arm cameras with warnings began on August 11, 2015. After the first week of school, BPS had two violations that were forwarded to the police. Initially, the warning phase was scheduled to last one month, but the police department ultimately made the decision to run the warning phase indefinitely, issuing only warnings unless there was a second violation in which case a citation would be issued. In March 2016 BPS established a relationship with the Sarpy County Sheriff's Office and began sharing stop-arm video from buses with routes in the county since they were better able to address violations which occurred out of the Bellevue's jurisdiction.

4.3.4 Rankin County (Mississippi) School District

RCSD is the third largest school district in Mississippi and serves more than 20,000 students, has 28 schools and 280 buses. After *Nathan's Law* (see the Legislation section that follows) passed in 2011, RCSD bus drivers began completing forms when illegally passed (See Figure 3). Table 5 provides a timeline of Rankin County program.

In 2015 RCSD made several purchases to add stop-arm cameras to their school buses. These purchases included 4-camera systems as well as purchases of 2-camera sets to add to buses with existing interior camera systems. By the end of 2015, about 20% of RCSD's school buses were equipped with stop-arm cameras. These purchases continued over the following years, with the stop-arm equipped percentage of school buses increasing to about 30% in 2016.

Table 5. Overview of Rankin’s Program Timeline

Program Phase	Date	Event
	May 4, 2015	MS NEWS NOW reports a fatality resulting from an illegal school bus pass, documented with a GoPro camera
	January 20, 2016	WJTV12 runs story on students using a contest to help make bus rides safer
Pre-Implementation	February 2-29, 2016	Pre-Implementation phase
Warning	March 1-31, 2016	Warning phase
Post-Implementation	April 1, 2017	Begin Post-Implementation phase
	May 20, 2016	Last day of 2015-2016 school year
	August 9, 2016	First day of 2016-2017 school year
	March 13-17, 2017	Spring Break (no school)
	May 23, 2017	Last day of 2016-2017 school year
	August 8, 2017	First day of 2017-2018 school year
	August 23, 2017	Mississippi Public Broadcasting (MPBOnline) makes online announcement of <i>Operation Stop</i> to increase school bus awareness and safety and outline Nathan’s Law
	May 24, 2018	Last day of 2017-2018 school year

4.3.4.1 Legislation

In 2011 the Mississippi State legislature passed a bill to increase penalties associated with passing a stopped school bus. This law, “Nathan’s law” was named after a five-year-old child who died after a driver illegally passed a school bus striking the child. Nathan’s law included several measures intended to improve school bus safety in Mississippi. The law required motorists to stop at least 10 feet from a school bus when the bus is loading or unloading children, and prohibited proceeding until all children had crossed the street, the flashing red lights were no longer activated, and the stop sign on the side of the bus was retracted. Further, the law authorized a charge of felony assault and a prison sentence of up to 20 years for any motorist convicted of illegally passing a school bus and, in that process, causing an injury or fatality. The law also increased the fine for passing a stopped school bus.

In addition to penalties Nathan’s law authorizes cameras on school bus stop-arms to record drivers who illegally passing school buses. It required the development of at least 10 questions related to school bus safety for the driver’s license exam. The law established a School Bus Safety Task Force, and prohibited school bus drivers from using cell phones, wireless communication devices, vehicle navigation systems, or personal digital assistants while operating the bus.

4.3.4.2 Bus Driver Forms

RCSD tracked illegal passes via bus driver forms since 2011. These forms included fields for basic information about the event: date, time, and license plate number. An example of one such form is shown in Figure 3.

Figure 3. Bus Driver Form Used by RCSD

Driver Report: Failure to Obey Stop Sign

The vehicle described in this report was witnessed passing a Rankin County school bus when loading/unloading students while red warning lights were activated and the stop sign was extended.

*Date of Event: _____ Time of Event: _____ AM/PM

*Car Tag Number: _____

Location of Event: 2767 Flowood Dr. at Dexter Dr.
Flowood Ins.

Description of Vehicle: Red Ford Truck not sure
if it was SUV or four doors
it passed me too quickly.

Description of Driver: Did not see Driver.

The vehicle passed the bus: from the rear from the front

Additional Comments: I had all lights flasher stop sign on
OUT WORKING truck just passed me.

*In signing this document, I, the undersigned bus driver/witness, hereby affirm that all of the above information is true.

Bus Driver/Witness Name: (print) _____ Bus #: _____

Bus Driver/Witness Signature: _____ Date: _____

*Indicates a field that is required
**This form must be submitted to the school zone transportation supervisor.

4.3.4.3 Media Campaigns

When enforcement of the program began in April 2016, the RCSD director of public relations issued a press release. A local media outlet ran a story highlighting the enforcement program. At the beginning of the 2016-2017 school year, RCSD worked with local media outlets to run stories on school bus safety and the RCSD program.

4.3.4.4 Warnings and Citations

After the program began, the district's drivers for all 280 buses continued to complete the stop-violation forms as they had before. In addition, drivers of the 58 buses equipped with the exterior cameras were trained to use "event markers" to tag illegal passes on the video record. The drivers provided this information each day to their school safety officers, who used the event markers to pull up the video clips of the passes. RCSD then provided the video clip, or simply an image of the license plate of the offending vehicle, as well as the bus driver form that was completed to law enforcement.

RCSD's implementation had three phases: pre-implementation, a warning period, and post-implementation. The pre-implementation period served as a baseline period where illegal passes were tracked but no warnings were issued and there was no special public outreach. During the warning phase, drivers making illegal passes received only warnings. During the post-implementation phase, drivers received citations for the illegal passes and the media campaign was initiated. The timeline for these three activities is shown in Table 6.

Table 6. Implementation timeline for the Rankin County School District

Phase	Start Date	End Date
Pre-Implementation	February 2, 2016	February 29, 2016
Warning	March 1, 2016	March 31, 2016
Post-Implementation	April 1, 2016	May 24, 2017*

**RCSD's summer vacation occurred May 20, 2016 to August 8, 2016. During this time, the cameras were not being used.*

4.4 Data Collected from the Participating Districts

This section describes the data collected from the three participating school districts. The data consisted of obtaining records of the violations observed before and after implementation, documenting media coverage of the three stop-arm camera implementations, and adjudication outcome.

4.4.1 Violation Data and Adjudication Outcome

Data on stop bar violations were obtained from Arlington, Bellevue, and Rankin counties as well as two cities within Rankin (Flowood and Richland). Appendix C documents the final data set produced.

4.4.1.1 Arlington

Arlington Public Schools' bus drivers conducted a survey of illegal passes in the 2014-2015 and 2016-2017 school years. For several dates, each bus driver completed a form for each illegal pass including the time (morning, mid-day, or afternoon), whether the passing vehicle was coming from the front or rear, and whether the vehicle passed on the left or right. This information was submitted for the project as an indication of the frequency of illegal passes.

The Arlington County court system provided information on officer-observed instances of illegal school bus passes, including the date and time of the incident, the driver's name, whether a citation or warning was issued, any amendments to the original charge, and the final verdict.

Arlington did not directly submit data from its stop-arm cameras, but was among the jurisdictions included in the vendor-provided data which will be discussed in a later section of the report.

4.4.1.2 Bellevue

Bus drivers recorded information on each observed illegal pass via paper forms. Each form included the date and time of the pass, a bus identifier, the license plate of the passing driver, whether the vehicle came from the front or rear, and how the pass was observed. Starting in the 2015-2016 school year, some buses were outfitted with stop-arm cameras; at that point, illegal passes were observed by the drivers (via paper forms), captured by the camera system, or both. Bellevue submitted a consolidated spreadsheet of the forms and camera observations for analysis. The data covers the period from the 2008-2009 to the 2016-2017 school years, but the 2009-2010 school year was omitted.

4.4.1.3 Rankin

Rankin County provided two data sets. Bus drivers recorded illegal passes on paper forms, including the time and date of the incident, bus and passing driver identifiers, and the whether the vehicle came from the front or rear. As the bus driver forms were used to identify illegal passing collected via video, separate data extracted from the video was not collected from the locality. Proceedings from 21 traffic court cases concerning passes that occurred between November 1, 2011, and February 1, 2018, were also provided, including the time and date of the incident, bus and passing driver identifiers, and the verdict. In addition, two cities in Rankin County – Flowood and Richland – provided similar traffic court data (35 and 21 cases, respectively).

4.4.2 Media and Public Awareness Campaigns

All three jurisdictions conducted outreach efforts to educate and inform the public. These efforts included press conferences, press releases, web pages on district sites, Twitter mentions, and earned media. Partial documentation of these outreach efforts was provided by the cooperating jurisdictions. In addition, periodic web searches were conducted by the research team to identify earned media coverage. Outreach and media coverage for each district is documented in Appendix A.

4.4.3 Stakeholder Discussions

The research team conducted interviews with each district's transportation director, and several law enforcement officers and bus drivers. (See Appendix B: Stakeholder Feedback.) These discussions were used to elicit feedback about the camera program from different perspectives and posited questions on topics such as what worked, what would you change, program reception, and advice to other districts.

4.5 Analysis and Results of the Examination of the Three Districts

Both qualitative and quantitative data was used to assess the effect of stop-arm cameras on illegal school bus passing. In addition, the research team conducted interviews with each district's transportation director, and several law enforcement officers and bus drivers. (See *Appendix B: Stakeholder Feedback* and *Appendix C: Data File Contents and Coding Manual*.)

4.5.1 Statistical Analysis Metrics, Inconsistencies, and Assumptions

The ideal metric for assessing the effect of stop-arm cameras would be the probability of an illegal pass at each opportunity to do so (i.e., each stop made by each bus). Such information was not made available for this study, so another metric was developed: *the number of illegal passes per active bus per school year*. Unlike monthly counts, this annual metric is less subject to differing numbers of school days (i.e., data collection days), and temporary policies putting greater emphasis on enforcement of school bus passing laws. Buses equipped with stop-arm cameras or operated by bus drivers completing paper forms were considered “active.” In jurisdictions only providing information on passes observed by law enforcement officers, all buses in the school district were considered active. With no transparency into the enforcement strategies and policies among law enforcement officers in these jurisdictions, this assumption was necessary in calculating annual illegal pass rates.

Passes per active bus per time period (month or school year) describes the *rate* of illegal school bus passing and provides a standardized metric for analysis of variation over time. The number of illegal passes was calculated for each bus within each month and school year; means and 95% confidence intervals were then constructed for each school year. This approach assumed that buses not reporting any passes during an entire school year did not report them. School administration personnel were unable to pinpoint camera installation or bus decommissioning dates, but it was clear from the data that some rate of attrition was present. Prior work in this field suggests that the rate of passing is high enough to justify this assumption.

The observational data collected over the course of this research was not ideally suited to hypothesis testing. Missing values were common, and data collection methodologies were inconsistent across the districts. Some of the challenges and caveats of the data and subsequent analysis to be aware of when interpreting the results are noted below.

The Arlington bus driver surveys were administered sporadically. One day of data collection occurred in February 2015, while 3 days occurred during both June 2015 and March 2017. Some bus drivers provided responses to multiple surveys and some did not. The drivers who did provide responses may have done so because they were experiencing abnormally high rates of illegal passing. If so, this data is biased toward more passes.

Traffic court records were submitted by Arlington and Rankin Counties, as well as Flowood and Richland cities (both within Rankin County). Unlike camera-observed passes, illegal passes observed by officers were subject to changing priorities within each precinct. Without detailed information on policy shifts or some measure of exposure (i.e., how many *opportunities* for illegal passes were observed by officers), using officer observed passes, it is impossible to determine if illegal school bus passing increased or was simply observed more often.

The number of active buses had to be estimated differently for jurisdictions submitting only traffic court records. When passes were reported exclusively by law enforcement officers, all buses were presumed to have had some chance of being observed during an illegal pass. When calculating the number of passes per bus per school year from traffic court data, all buses within a school district were considered active.

Driver-observed passes were subject to the same biases as officer-observed passes. Bus drivers who considered passing a serious problem may have been more likely to complete the form to report incidents. Further, bus drivers may have been more responsive when school administration put more emphasis on the importance of the reporting forms. This seems to have happened in Rankin; during the 2015-2016 school year, more than four times as many forms were submitted than in any other school year from 2010 through 2017. Although Nathan’s Law went into effect near the end of the 2010-2011 school year, it did not generate a substantial increase (from added emphasis to catch illegal passers) or decrease (from an increased rate of compliance among drivers) in driver-observed passes relative to subsequent years.

After attempting to mitigate these limitations, the rate of illegal passing was quantified for each jurisdiction and each data collection method (camera, bus driver, officer, and court records) to assess how much illegal passing is occurring. The impact of the stop-arm cameras was quantified in jurisdictions with such programs. Rates of recidivism and outcomes of traffic court cases were also examined.

4.5.2 How Much Illegal Passing is Occurring?

Rates of illegal passes per bus per school year varied substantially among data collection methods and jurisdictions. Table 7 shows the average number of illegal passes per bus per year in each jurisdiction using each source. Years of data varied across jurisdictions.

Table 7. Summary: Average number of illegal passes per bus per school year for each jurisdiction and source

Jurisdiction	Source			
	Bus Drivers, Continual	Bus Drivers, Survey	Law Enforcement Officers	Stop-Arm Cameras
Arlington	-	195.4	1.06	16.8
Bellevue	3.8	-	-	8.4
Rankin	1.6	-	0.01	-
[Camera Vendor]*	-	-	-	47.9

Note: Refer to the previous section for data assumptions and limitations.

**Camera Vendor data did not come from the three participating jurisdictions referenced in this section; however, this information was included here for comparison purposes between each data collection source. For more information on camera vendor data, see Section 5.*

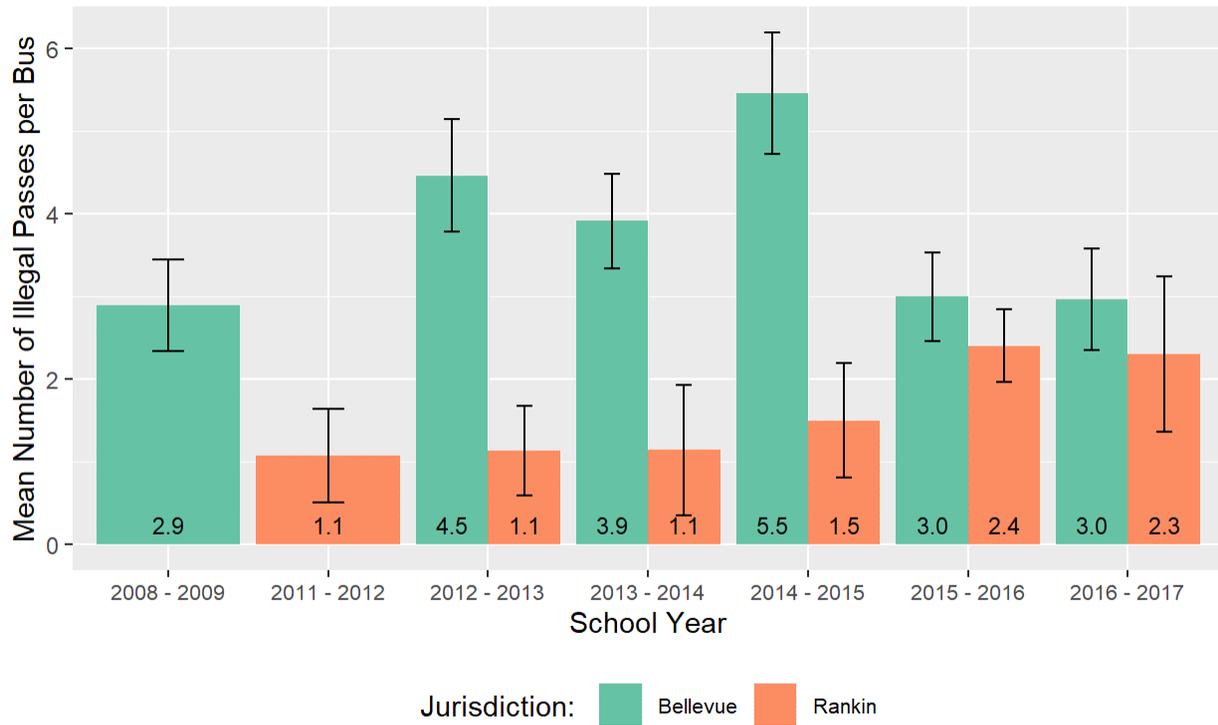
Data from different sources and jurisdictions allows for several interesting comparisons that shed light on both the problem of illegal passing and the methods used to measure it. The following sections compare pass rates between and within jurisdictions and sources.

4.5.2.1 Bus Drivers (Continual Collection): Bellevue and Rankin

Bellevue and Rankin submitted data on passes observed by bus drivers on a continual basis for several years prior to this study as well as passes observed during the study. As mentioned previously, Arlington bus drivers were surveyed on specific days rather than throughout the school year.

Camera installation in Bellevue began during the 2015-2016 school year; although bus drivers were instructed to complete the forms, they may have relied on the cameras. Across all years of available data, the driver-observed average annual rate of illegal passing per school bus in Bellevue and Rankin was 3.8 and 1.6, respectively. Given the number of school buses in each jurisdiction, this amounts to 296 and 448 illegal passes per year in Bellevue and Rankin, respectively. Figure 4 shows the number of passes observed and reported by bus drivers per active bus per year.

Figure 4. Driver-Observed Passes per Bus per School Year in Bellevue and Rankin

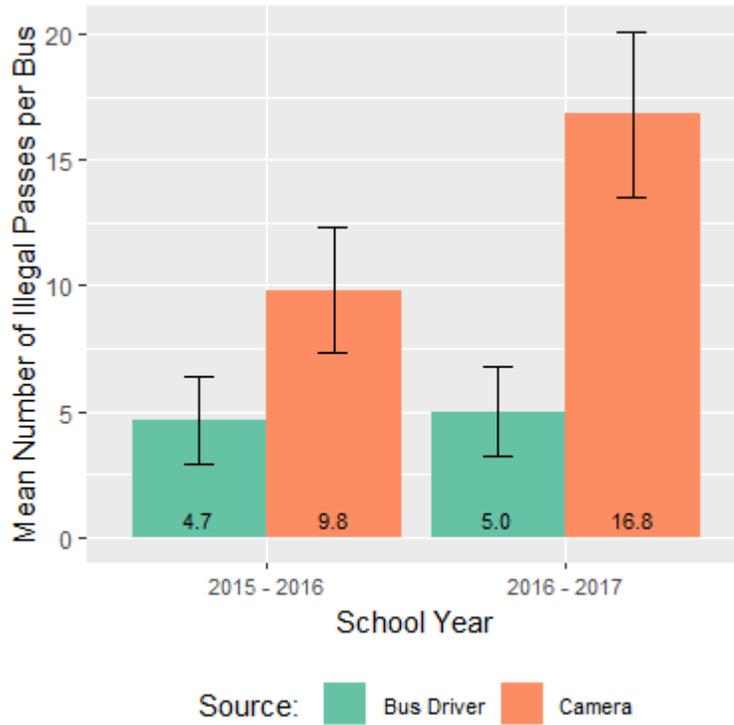


4.5.2.2 Bellevue: Bus Drivers (Continual Collection) and Cameras

Buses in Bellevue were outfitted with stop-arm cameras beginning in the 2015-2016 school year. Data on camera-observed passes¹ was provided for analysis. Of 55 school buses reporting illegal passes in Bellevue during the 2015-2016 and 2016-2017 school years, six buses reported passes observed by bus drivers *and* stop-arm cameras during *both* school years. These buses present an opportunity to directly compare the two observation methods. Figure 5 shows the difference in reporting rates among these six buses for each source. On average, annual pass rates were 2.7 times higher when observed by stop-arm cameras than by bus drivers. This difference suggests that bus driver observation underestimates the rate of illegal passing by a factor of 2.7.

¹ In Bellevue some passes were coded as being reported by both the bus driver and the camera. In the graphs and statements comparing reporting rates from these sources, a pass reported by “both” counted as one pass for the bus drivers *and* one pass for the stop-arm camera. For example, if five passes were recorded by the bus driver, two by the stop-arm camera, and one for “both,” the final count would be six for the bus driver and three for the camera.

Figure 5. Passes per Bus per School Year in Bellevue, by Source
 (Only for the Six Buses Capturing Passes Using Both Bus Drivers and Cameras)



4.5.2.3 Rankin: Bus Drivers (Continual Collection) and Law Enforcement Officers

Rankin submitted data on illegal passes observed by bus drivers, but Rankin’s secondary source was officer-generated citations. Figure 6 shows the difference in reporting rates from these two sources. The number of buses reporting driver-observed passes was 15 or less for each school year except 2015-2016 when 47 driver-observed (and zero officer-observed) passes were reported. When calculating the rate of passes per bus per school year from officer-observed passes, each bus in the county was assumed to have an equal probability of being monitored by a law enforcement officer, thus the number of active buses is 280. On average, annual pass rates were nearly 200 times higher when reported by bus drivers than when relying on law enforcement to witness a pass. Such a difference is not surprising as law enforcement officers have to monitor a route or happen to be at a stop to witness illegal school bus passes, while bus drivers are directly privy to all passes as they are the driver in control of the route and constantly monitoring surrounding traffic. Further, law enforcement presence may discourage some drivers from committing the violation.

Figure 6. Passes per Bus per School Year in Rankin, by Source



4.5.2.4 Arlington: Bus Drivers (Date Point Surveys), Law Enforcement Officers, and Cameras

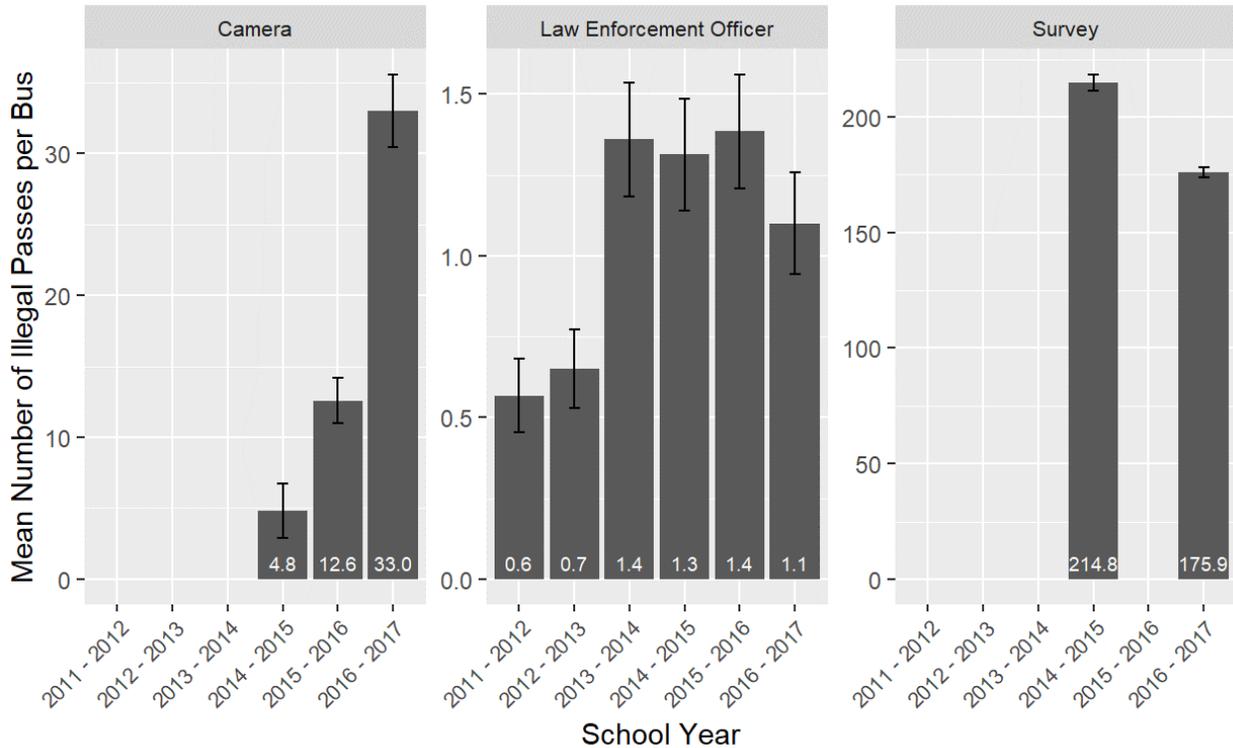
Arlington provided data from two bus driver surveys and officer-generated citations. In addition, stop-arm cameras were installed on buses beginning in the 2014-2015 school year. Data on passes observed by these cameras was provided by the camera vendor, allowing for a comparison of all three methods in one jurisdiction over time. Figure 7 shows the difference in reporting rates from each source. Officer-generated citations are fairly steady across years and consistently the lowest. As in Rankin, this is likely due to the limited number of officers available to surveil all the county’s school buses, and the increased level of caution among drivers in the presence of marked police cars. In contrast, the rate of camera-observed passes steadily increased from the 2014-2015 school year through the 2016-2017 school year. Notably, the rate increased from 2015-2016 to 2016-2017 despite an unchanged number of active buses (19) in these two school years.

Bus driver surveys produced extremely high average pass rates (approximately 200 per bus per year, or more than one per day). Note that the surveys asked how many passes each bus driver had experienced *on the date of the survey*. Data collection spanned 4 days (1 in February and 3 in June) during the 2014-2015 school year and 3 days (all in March) during the 2016-2017 school year. Passing rates were annualized by multiplying the average daily passing rates by (180/4) and (180/3) for each respective school year.² Several factors may explain the extreme values. First, the survey dates may not be representative of typical school days. If even slightly more passes were observed on the survey dates, annualizing the responses would exaggerate the variance. Second, bus drivers responding to the survey may have been affected by demand characteristics. Particularly, “good-participant role” describes participants’ tendency to attempt to confirm the perceived hypothesis of the survey (Nichols, 2008). In other words, bus drivers may have reported more illegal passes (whether intentionally or unintentionally) than they could reliably

² Each school year was assumed to span 180 days.

recall in order to demonstrate a high rate. Finally, the high pass rate indicated by the survey may be the “true” rate as stop-arm cameras may miss a non-trivial number of passes given the required collection and review protocol and law enforcement are not omnipresent at bus stops.

Figure 7. Passes per Bus per School Year in Arlington, by Source*



* Due to large differences in school bus passes by source, all figures are on different scales.

4.5.3 Stop-Arm Camera Enforcement Program Results

To reiterate, Arlington, Bellevue, and Rankin implemented programs to phase in the use of stop-arm cameras to report and deliver citations to drivers who illegally pass school buses (see Table 2 for program dates). These dates (or phases) allow for before-and-after analyses of passing rates, though each jurisdiction experienced circumstances undermining the quantification of program impact.

4.5.3.1 Arlington

Bus drivers recorded passes observed on surveyed days. Table 8 shows the dates of each survey and the starting date of the associated implementation phase. The first survey wave consisted of just one day of data collection and was administered 93 days prior to the beginning of the pre-implementation phase. The following wave spanned 3 days, starting 33 days into the pre-implementation phase. The final wave spanned 3 days, starting 178 days after the October 3, 2016, implementation.

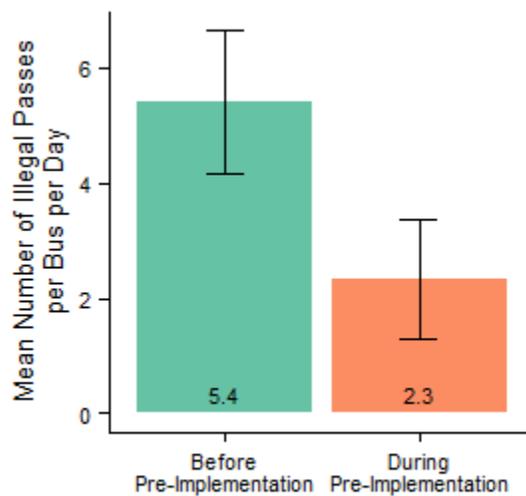
Table 8. Survey Dates Relative to Implementation Phases in Arlington

Survey Wave	Survey Date	Phase	Phase Start Date
1	February 3, 2015	Before Pre-Implementation	N/A
2	June 9, 2015	Pre-Implementation	May 7, 2015
2	June 10, 2015	Pre-Implementation	May 7, 2015
2	June 11, 2015	Pre-Implementation	May 7, 2015
3	March 28, 2017	Post-Implementation	October 3, 2016
3	March 29, 2017	Post-Implementation	October 3, 2016
3	March 30, 2017	Post-Implementation	October 3, 2016

Paired *t*-tests of the number of passes reported per bus *per day* were performed. Unpaired *t*-tests would ignore the correlation of values within each bus, but paired *t*-tests can only be applied to cases with values both “before” and “after.” The first test compared daily pass rates among buses with responses to the February 3, 2015, survey and at least one of the surveys in the second wave; the other test compared daily pass rates among buses with responses to at least one survey in the second and third waves. Pass rates among buses with responses to more than one survey in any wave were adjusted to a single daily pass rate for the survey wave. For example, if a bus recorded five passes on June 9, 2015, zero passes on June 10, 2015, and did not respond on June 11, 2015, that bus’s daily pass rate for the second wave would be $(5 + 0)/2 = 2.5$.

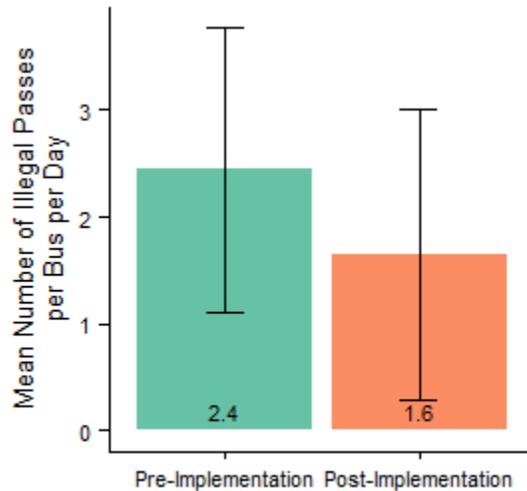
Eighteen bus drivers responded to the first survey wave and at least one survey in the second wave. Figure 8 shows the average and 95% confidence intervals for daily pass rates for these two waves (before pre-implementation and during pre-implementation). Daily passing rates during the first survey wave averaged 5.4 (with a 95% confidence interval of 4.1 – 6.6) versus 2.3 (1.3 – 3.4) during the second wave. Using a one-sided paired *t*-test ($t = -4.1, df = 17, p < 0.001$), this decrease was statistically significant.

Figure 8. Daily Pass Rates in Arlington:
Before Pre-Implementation Versus During Pre-Implementation



Fourteen bus drivers responded to at least one survey in waves two and three. Figure 9 shows the average and 95% confidence intervals for daily pass rates for these two waves (pre-implementation and post-implementation). Note that the pre-implementation mean differs between the two graphs due to the inclusion criterion for each paired *t*-test (i.e., buses must have responded to at least one survey in each wave to be tested). Daily pass rates during the second survey wave averaged 2.4 (with a 95% confidence interval of 1.1 – 3.8) versus 1.6 (0.3 – 3.0) during the third wave. Using a one-sided paired *t*-test ($t = -0.08$, $df = 13$, $p > 0.2$), this decrease was *not* statistically significant.

*Figure 9. Daily Pass Rates in Arlington:
Pre-Implementation Versus Post-Implementation*



Interestingly, no major media campaign events occurred between the first two survey waves, despite a statistically significant decrease in passes per bus per month. Nine news releases were found between the second and third survey waves, but they do not appear to have had a significant impact.

4.5.3.2 Bellevue

Bellevue’s pre-implementation phase began in March 2014 and ended in August 2015, from which point only warnings were issued to offending drivers (with only repeat offenders issued citations). The beginning of this warning phase coincided with the installation and use of stop-arm cameras. Bus drivers were asked to continue using paper forms even if a stop-arm camera was installed. Figure 10 shows the temporal relationship between these phases, data collection methods, and the academic calendar; and identifies groupings for valid statistical comparisons. Comparison group A spans the 2014-2015 school year and occurs completely within the pre-implementation phase. Comparison groups B and C span the 2015-2016 and 2016-2017 school years, respectively, and occur completely within the warning phase. A decrease in groups B or C relative to group A would indicate program success.

Figure 10. Visualization of Comparison Groups in Bellevue Relative to School Year, Implementation Phase, and Data Collection Method

Calendar Year	2014				2015				2016				2017											
Month	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
School Year	2014-2015								2015-2016								2016-2017							
Phase	Pre-Implementation												Warning											
Data Collection Method	Bus Drivers												Bus Drivers and Cameras											
Comparison Groups	A								B								C							

Figure 11 shows the total number of illegal passes observed each month, as well as the breakdown by source (bus driver or camera) among buses outfitted with cameras. The height of each bar represents the total count, while heights of each color correspond to the number of passes observed by each source. In most cases, the number of camera-observed passes is greater than the number of driver-observed passes. Drivers were asked to continue using the paper forms despite being equipped with stop-arm cameras, and it appears that they did so. This behavioral consistency is important to the validity of the comparisons between the pre-implementation and warning phases. If bus drivers had decreased their use of the paper forms, producing lower passing rates in the warning phase relative to the pre-implementation phase, the decrease could be incorrectly attributed to the warnings.

Figure 11. Monthly Illegal Passes in Bellevue by Source, Among Buses* Outfitted With Stop-Arm Cameras

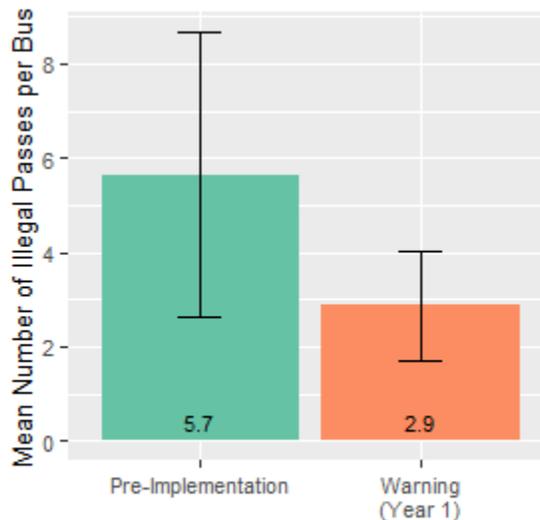


*Note: Each bus was designated using a 4-digit code, e.g., 07c7, 0b5f.

Driver-observed passing rates during the pre-implementation phase (2014-2015 school year) were compared to rates in the two subsequent school years, both in the warning phase. Rates during those two years were also compared to detect any trends during the warning phase. Passes observed by stop-arm cameras were excluded to avoid confounding the warning phase with the data collection method. One-sided paired *t*-tests were used to compare rates between periods among buses that reported passes in both periods. Doing so leads to different samples (and sample sizes) for each comparison: 23 buses reported driver-observed passes in both the pre-implementation phase and first warning phase year, while 16 reported passes in the pre-implementation phase and the second warning phase year, and 19 reported passes in both warning phase years.

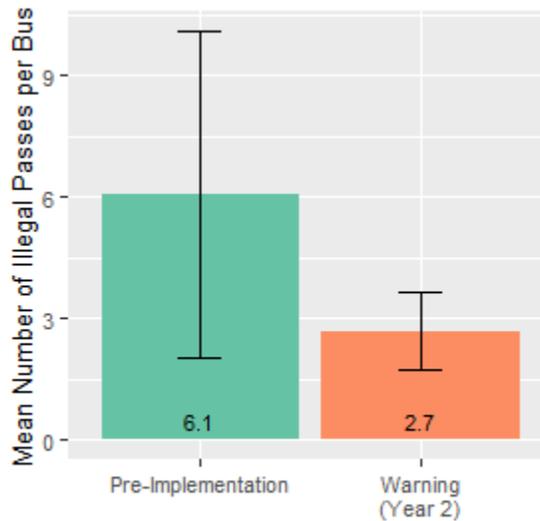
A total of 23 bus drivers reported passes during the 2014-2015 (pre-implementation phase) and 2015-2016 (first year of warning phase) school years. Figure 12 shows the average and 95% confidence intervals for annual pass rates for these two periods. Annual pass rates during the pre-implementation phase averaged 5.7 (with a 95% confidence interval of 2.6 – 8.7) versus 2.9 (1.7 – 4.0) during the first year of the warning phase. Using a one-sided paired *t*-test ($t = -1.9, df = 22, p = 0.04$), this decrease was statistically significant.

Figure 12. Annual Pass Rates in Bellevue: Pre-Implementation Versus Warning Phase (Year 1)



Sixteen bus drivers reported passes during the 2014-2015 (pre-implementation phase) and 2016-2017 (second year of warning phase) school years. Figure 13 shows the average and 95% confidence intervals for annual pass rates for these two periods. Annual pass rates during the pre-implementation phase averaged 6.1 (with a 95% confidence interval of 2.0 – 10.1) versus 2.7 (1.7 – 3.7) during the second year of the warning phase. Using a one-sided paired *t*-test ($t = -1.9, df = 15, p = 0.04$), this decrease was also statistically significant. Note that a slightly different set of buses was used for this and the previous comparison, hence the difference in mean annual pass rates during the pre-implementation phase.

Figure 13. Annual Pass Rates in Bellevue: Pre-Implementation Versus Warning Phase (Year 2)



Nineteen bus drivers reported passes during the 2015-2016 (first year of warning phase) and 2016-2017 (second year of warning phase) school years. Annual pass rates during warning phase year one averaged 3.4 versus 3.3 during warning phase year two. A one-sided paired *t*-test ($t = 0.9$, $df = 18$, $p = 0.43$) suggests this decrease was statistically insignificant.

4.5.3.3 Rankin

Rankin used one-month-long pre-implementation and warning periods, starting in February 2016 and leading up to the post-implementation phase in April of the same year. Among 91 buses that were active (the bus driver recorded passes) during both the pre-implementation and warning phases, a paired *t*-test ($t = 0.8$, $df = 90$) revealed a statistically insignificant decrease from 0.2 (with a 95% confidence interval of 0.1 to 0.3) to 0.1 (0.0 – 0.2) passes per bus per month. Statistically insignificant ($p > 0.05$) differences were also found between the pre-implementation and warning phases, between the warning and post-implementation phases, and between the pre-implementation phase and twelve months later. Passing rates during this time (January 2016 – April 2017) averaged 0.06 (0.04 – 0.08) passes per bus per month. While the average rate decreased, the number of illegal passes was already low so it is understandable that the decrease was not deemed statistically significant. In addition, the Rankin media campaign may not have been sufficient to lower the illegal passing rate further; just one major news release was identified 11 days prior to the pre-implementation phase (40 days prior to warning phase, 71 days prior to post-implementation phase) with no other occurrences until August 2017.

4.5.4 How Many Drivers Are Repeat-Offenders?

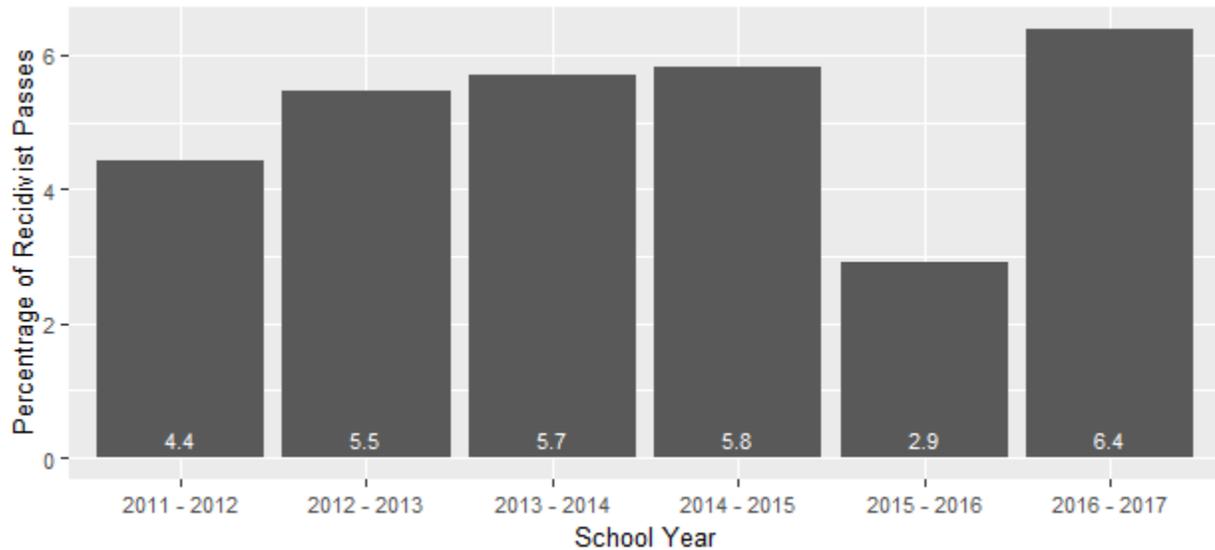
Repeat offenses may indicate a lack of knowledge about school bus passing laws – or an intentional disregard for them. Recidivism was investigated in Arlington, Bellevue, and Rankin Counties, and Richland city (within Rankin County). Jurisdictions included in the vendor-provided stop-arm camera data set are discussed in Section 5.

In Arlington only one driver of 1,089 drivers observed illegally passing school buses was cited as a repeat offender between January 2012 and October 2017. The first charge was amended to “failure to pay full time and attention;” the second offense occurred nearly four years later and received a “guilty” verdict.

Recidivism was higher in Bellevue. As a percentage of all illegal school bus passes, recidivism increased consistently from 2011-2012 to 2014-2015, as shown in Figure 14. During the 2015-2016 school year, the

percentage of recidivist passes dipped substantially, possibly as the result of the beginning of the warning phase (during which only recidivist drivers received citations). In the following year, however, recidivist passes reached a new high of 6.4%. Recidivist drivers passed an average of 1.2 unique buses.

Figure 14. Percentage of Recidivist Passes in Bellevue, by School Year



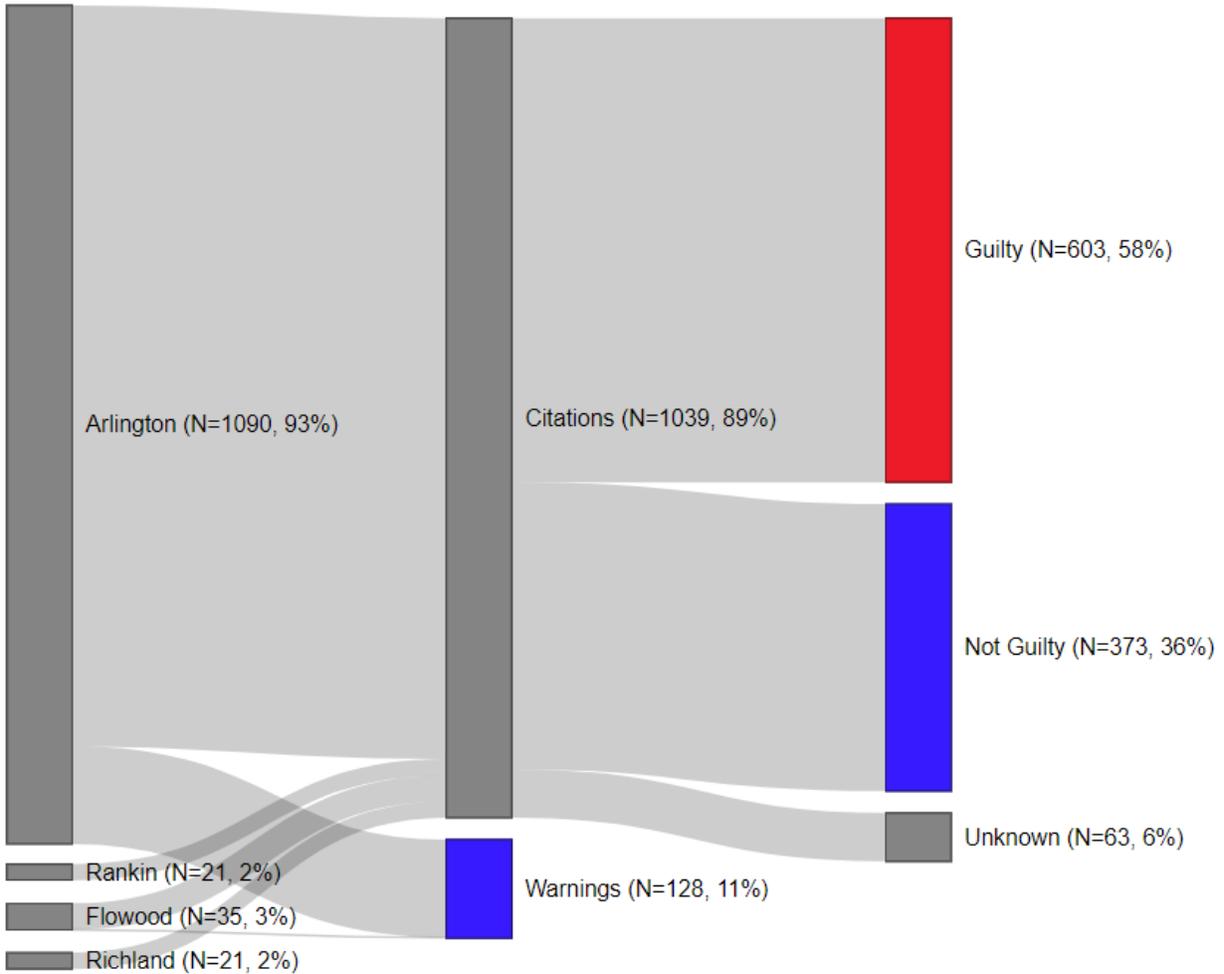
Rankin County provided two data sets to investigate recidivism. One driver of the 18 cited in court records illegally passed a school bus twice. Interestingly, this driver was charged with “interference with the operation of a school bus” and “meeting or overtaking a school bus” each time (for a total of four charges concerning two incidents). The first incident resulted in fines, but the second (presided over by a different judge) earned the offender jail time.

According to the bus driver forms, 12% of drivers who passed stopped school buses did so numerous times during the 2013-2014 school year. Subsequent years saw decreasing rates of recidivism, ending at 9% in the 2016-2017 school year. Court records in Richland (a city in Rankin County) show that of 20 drivers convicted of passing a school bus, one was cited twice, one month apart, and was found guilty both times.

4.5.5 How Do the Courts Treat Illegal School Bus Passes?

Arlington and Rankin Counties, as well as the cities of Flowood and Richland (cities within Rankin County) submitted traffic court proceedings for illegal school bus passes observed by officers in the field from different time periods. Figure 15 shows the disposition of these cases. Note that Rankin County and the city of Richland only submitted fully prosecuted cases, so the proportion of warnings compared to citations may be understated. Of the 1,167 passes observed by law enforcement officers, 128 (11%) resulted in warnings. Of the 1,039 cases that resulted in citations, 603 (58%) received guilty verdicts, while 373 (36%) did not, and 63 (6%) were still pending at the time the records were extracted.

Figure 15. Traffic Court Dispositions



4.5.6 Stakeholder Feedback

The research team conducted interviews with each district’s transportation director, and several law enforcement officers and bus drivers. These discussions were used to elicit feedback about the camera program from different perspectives and posited questions on topics such as what worked, what would you change, program reception, advice to other districts, etc. While specific responses can be found in *Appendix B: Stakeholder Feedback*, this section provides a general overview of the feedback.

Public support for photo enforcement varied widely. In areas with strong public support, concerns about existing programs consisted mostly of demands from parents for a camera-equipped bus on their child’s route.

When opposition was present, privacy issues tended to be at the center. Some people expressed concerns over the specific use of photographs of vehicles and drivers. Others had objections to “Big Brother”-type surveillance. In some jurisdictions, enforcement was viewed as a revenue generator rather than a safety measure. Transportation directors said that when strongly expressed, opposition can affect legislative efforts to allow photo enforcement.

Some districts benefited from the experiences of others. Particularly when a program existed within a State already, an experienced district could provide important information to a district that was considering adding photo enforcement. This assistance could include copies of documents (for example, a memorandum of understanding with law enforcement to allow review of photographs), advice on key players to engage, an overview of the sequence of the process, strategies for engaging the public, challenges and hurdles they faced, and pitfalls to avoid.

Bus drivers generally supported the cameras. In districts where not all buses are equipped with cameras, bus drivers requested camera-equipped buses. Bus drivers said they wanted the photo enforcement to be successful: they wanted illegally passing drivers to be cited. When bus drivers raised concerns about the cameras, it was because the bus drivers could not tell whether an illegally passing driver would be ticketed. Bus drivers said they were less concerned with punishment for the drivers of the passing vehicles and more concerned with preventing future passes.

Overall, school districts expressed satisfaction with the mechanical functioning of the photo enforcement equipment. Camera systems activated as expected, captured the views of passing vehicles, captured time/date/location tags, and stored the information with reasonable reliability. Minor maintenance, such as keeping lenses clear of dirt, was easily accomplished. When school systems contracted with an outside vendor, the vendor generally handled repairs when those were necessary.

In a State that required license plates only on the rear of vehicles, photos occasionally did not adequately capture the illegally passing license plate at certain angles. Photos at night were occasionally affected by headlight glare. Memory cards could be damaged by high temperatures. These failures occurred in only a small number of cases. Technological and mechanical challenges did not seem to be an important issue with the transportation directors.

Equipment cost was not a barrier in the three study districts. In two districts, the camera vendors provided the equipment and installation, and generally conducted the review of photos before the photos were provided to law enforcement. One of these jurisdictions added wi-fi, at its expense, to allow wireless uploading of data. The last district self-acquired low-cost camera systems and implemented their own review protocol.

5. Examination of Camera Vendor Supplied Data Results

A stop-arm camera vendor provided several years of data from cameras it had previously installed on buses in jurisdictions across the country. The data included 130,913 illegal passes observed among 34 jurisdictions from August 1, 2012, to June 30, 2017. Data included the jurisdiction in which the pass occurred, as well as the date, hour, bus identity, and license plate of the offending driver. No information on school bus stop-arm camera programs in these areas was provided (with the exception of Arlington – previously discussed in Section 4) for the 34 districts. While data was provided for the 2008-2009 school year for multiple districts, the majority of analyses focused on school years 2012-2013 through 2016-2017 to include all 34 districts.

5.1 Passing Rates

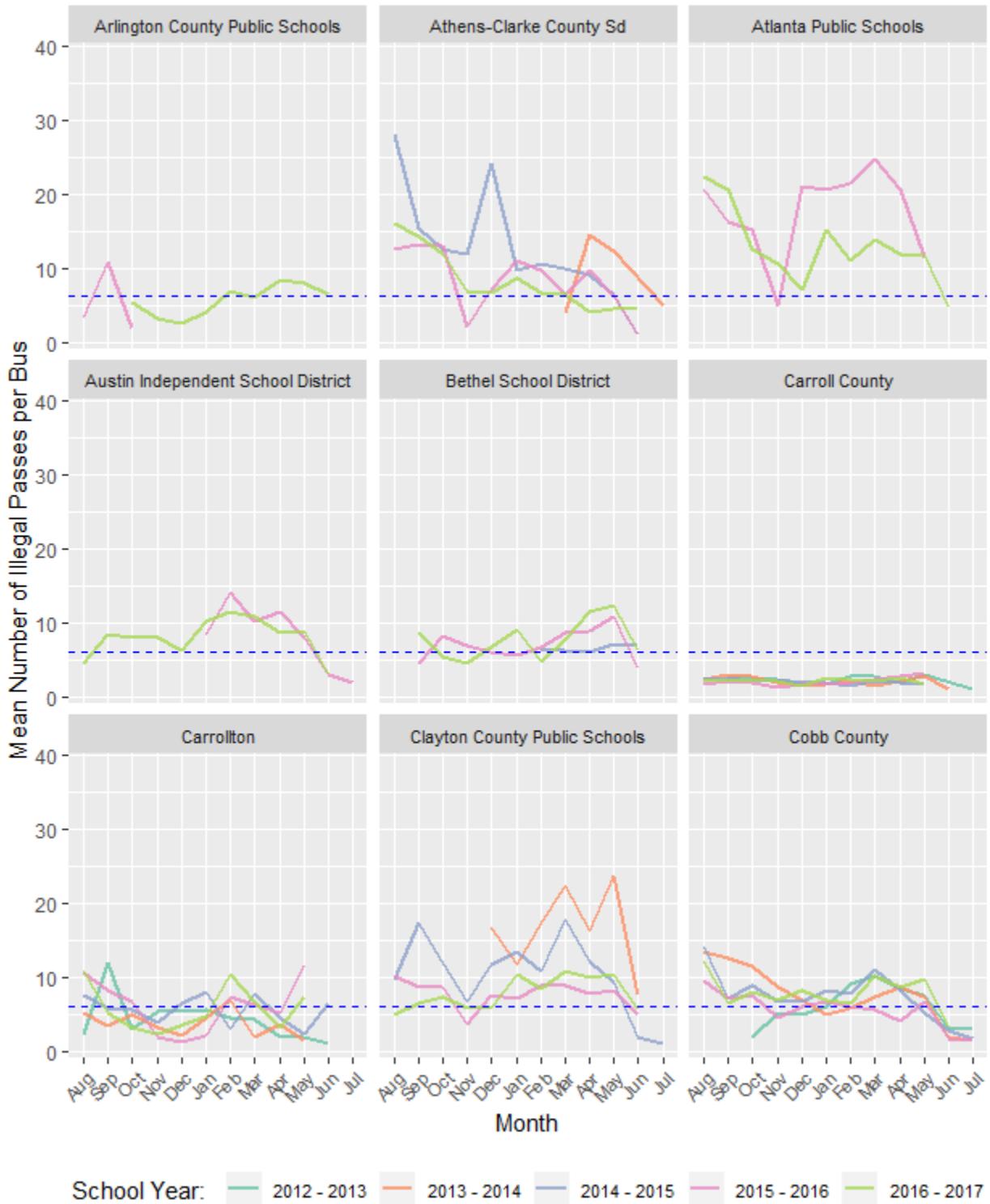
As program specifics were not provided for the vendor supplied data, passing rates in these jurisdictions are presented merely for context. Figure 16 shows the number of passes per bus per month in each jurisdiction with at least one full school year of data; the dashed blue line represents the grand mean (across all jurisdictions and months) for context. Across these jurisdictions and years, a typical school bus was illegally passed 6.1 times per month (denoted by the dashed blue line in Figure 16), or 47.9 times per school year. The highest rate was observed in Marietta City (just outside of Atlanta, Georgia), where nine buses were passed 346 times (38.4 passes per bus per month) during September 2014. This data is presented by month rather than school year to examine the seasonality of school bus passing; no clear cycle emerges.

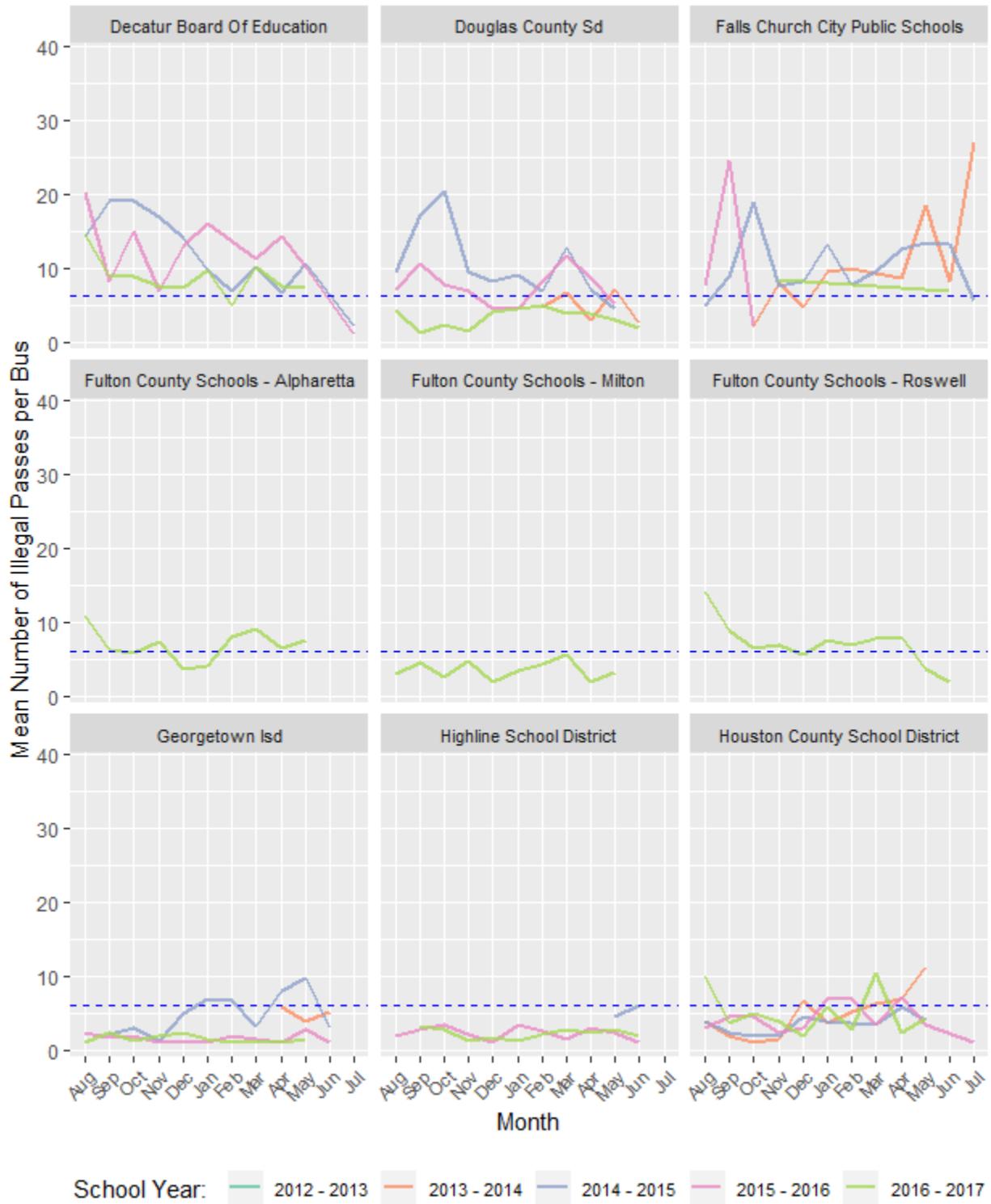
An interesting trend emerges concerning the time of day when illegal passes occur. Figure 17 shows the percent of illegal passes occurring in the afternoon hours (at or after 1 p.m.) across all school districts by school year. For most of each school year, approximately 60% of illegal passes occurred in the afternoon, but this proportion drops as summer arises. Note that the 0% observed in May during the 2008-2009 school year was calculated from just nine passes reported by three buses.

5.2 Repeat Offenses

As mentioned previously, repeat offenses may indicate a lack of knowledge about school bus passing laws – or an intentional disregard for them. Among the jurisdictions included in the vendor-provided stop-arm camera data, the percentage of recidivist *drivers* per school year was less than 3% for each jurisdiction. That is, of the drivers caught illegally passing school buses, fewer than 3% did so more than once. In total, 98.2% of drivers were caught passing once, 1.7% twice, 0.1% three times; 13 drivers (0.01%) passed four or more times. Note that drivers in this data were identified by vehicle plates, so there is some possibility that different individuals driving the same vehicle affected these statistics. Of 139,913 *passes* recorded by the vendor's stop-arm cameras, 2,447 (1.9%) were repeat offenses. By jurisdiction, recidivism was higher in Austin (2.7%) and Atlanta (2.6%). Interestingly, several jurisdictions exhibited peak recidivism during the 2014-2015 and 2015-2016 school years.

Figure 16. Passes per Bus per Month, by School Year and Jurisdiction





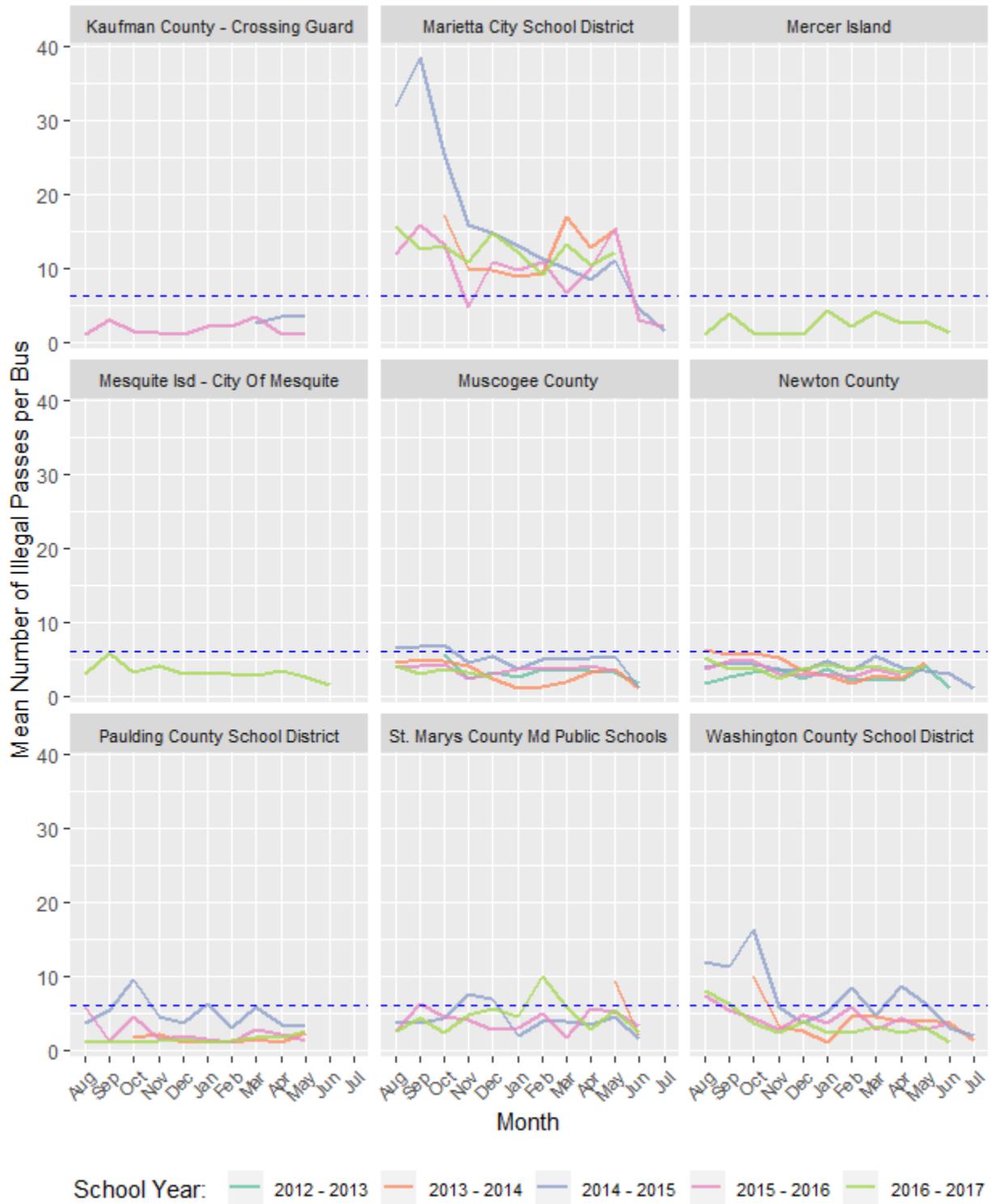
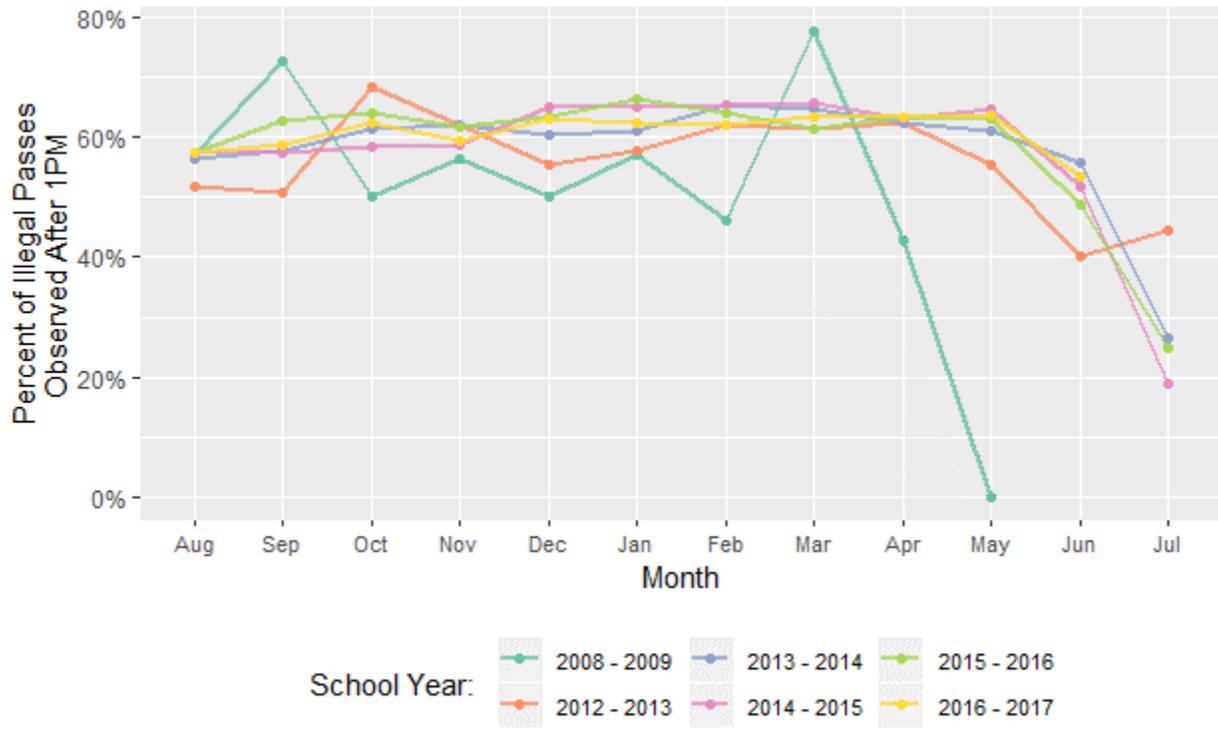


Figure 17. Percent of Illegal Passes Observed After 1PM Aggregated Across All Districts



6. Lessons Learned from School District Discussions

These following lessons learned were developed from the interviews of each district's transportation director, and several law enforcement officers and bus drivers.

6.1 Considering Program Partners

Interview participants noted the importance of considering school district staff members, jurisdictional agencies, and stakeholders who will be involved in any capacity with a stop-arm enforcement program, including school district transportation office staff, law enforcement, judges, bus drivers, parents, teachers, students, school administrative staff, school board, elected officials, information technology personnel, media, school bus mechanics, and camera vendors. Interviewees engaged these partners and talked with them during planning and throughout the program to discuss their concerns.

6.2 Talking with School Districts with Programs

Interview participants noted that school systems with stop-arm enforcement programs can provide guidance to help with planning and implementing a program. Further, they noted that agency staff who are operating a program can provide information on the unexpected challenges they encountered during the planning and implementation phases, strategies to overcome barriers, key partners and stakeholders to work with, and program costs and benefits. They can also share their lessons learned. For example, Arlington had incidents where teachers waved parents past a stopped school bus and those parents subsequently received citations in the mail. Knowing this type of event can occur will prevent others from repeating the same mistake. Interview participants also noted that school districts can provide documents such as a memorandum of understanding with a law enforcement agency that outlines responsibilities of both partners and the process for reviewing violations.

Districts noted the importance of planning and preparation. Districts who consulted with existing programs said they benefited from their ability to plan. Having an overview of another district's experience allowed them to anticipate needs, engage the right agencies and individuals, plan their media engagement, and avoid issues. Districts who did not have the benefit of other in-state districts' experiences were less able to anticipate needs and challenges and were less able to prevent issues. One official noted the need to plan the program from inception to implementation to continuing operations even before the program begins.

District personnel offered suggestions for purchasing and maintaining equipment. Considerations included these planning steps:

- Learn software requirements for camera systems including if your school district's existing computer platforms, e.g., Windows or MacIntosh, and network can support the software.
- Obtain extra memory cards as some will be needed for evidence and cannot be reused, and others will simply fail.
- Designate a laptop for the program, especially for downloading and reviewing video. This ensures that the software and video files will not interfere with the day-to-day office computers. This also allows staff to take the laptop to court if needed.
- Obtain associated cables and confirm they are of sufficient length to accommodate where the equipment will be placed.
- Use the highest number of frames per second. This will be helpful when video needs to be reviewed or specific frames need to be used in court. Also, test different camera orientations to ensure the cameras are best positioned to capture the required evidence.

6.3 Understanding what Law Enforcement Agencies Require to Prosecute a Violation

States and districts have varying legislation and requirements to issue passing citations. Interview participants valued familiarity with State laws and district ordinances and procedures. In some States, law enforcement officers need a clear image of the driver and especially a good facial image. This is a must when positive identification must be made and an officer did not directly witness the violation and see the driver. In all States, law enforcement must be able to identify the vehicle and license plate number. For example, when needed, the Richland Police Department (Richland is a city within the participating Rankin County district) will use license plate readers deployed in town to supplement the bus camera video. (Recall that this is a district initiated and maintained program.) These officers report that video from the bus cameras must show that the stop sign on the bus was fully deployed and there were children loading or unloading. Officers also reported that judges in this jurisdiction typically want clarification on whether children were loading or unloading from the school bus that was passed. Buses must be at absolute zero mph to reduce the risk of the case being dismissed. The Bellevue Police Department emphasized the need for a clear chain of custody so they can prove the video was not tampered.

6.4 Launching a Media Campaign

Many school districts operating a program report that media campaigns about bus cameras are effective, but noted that outreach needs to be constant. They worked with the school district's public relations staff, local newspaper, and other media outlets to promote the stop-arm enforcement program and raise awareness. They used social media to provide instant contact with people and educate drivers and raise awareness. Districts also said that public support was critical. From the first introduction of the concept through implementation, interviewees noted that public support is essential to engage the necessary agencies and resources. Particularly when legislative efforts are required from elected representatives, districts viewed public support as an important factor that makes photo enforcement possible.

6.5 Working with Legislators on State Laws and Local Ordinances

Stakeholders in Rankin County report that Nathan's Law reduced illegal passing because the penalties are non-negotiable as there are set penalties. Law enforcement officers in Nebraska report that it would be easier if the State law required that non-moving violations are issued to the vehicle's registered owner instead of the driver. In Rankin County the law permits officers to issue a citation to the owner of the vehicle if they cannot prove who was driving. However, it is challenging to persuade judges to convict someone who may not have been the driver. Districts conveyed that clear video resolution of the driver is still the best scenario to issue a citation.

6.6 Educating Drivers and Providing Additional Signage

Nearly all stakeholders interviewed suggested an education program for drivers to review circumstances when a driver needs to stop for a school bus. Many emphasized that drivers need to learn the meaning of the yellow flashing lights just as much as the meaning of the red flashing lights. Some school bus drivers suggested signs on the buses to alert drivers of camera enforcement as well as additional highway signs advising that it is unlawful to pass a school bus stopped to load or unload children.

6.7 Using Video for More than Issuing Citations

The Richland Police Department uses video footage to identify locations with a high rate of illegal passing so that law enforcement can perform targeted patrols in those areas. Bus drivers in Bellevue Public Schools and Rankin County School District report that the bus cameras have made them more aware of their own actions. They do not view this as negative, but rather a mechanism to ensure they are performing their job responsibly.

7. Conclusions and Discussion

The findings of the project revealed many aspects of the school bus stop-arm camera programs that should be planned and considered for implementation to be successful. These aspects include items such as:

- Development of legislation (including determination of appropriate fines, legal penalties, and consequences) that will ensure success for stakeholders including the school jurisdictions and law enforcement;
- Coordinating with the various judicial bodies to ensure prosecution of State or local laws;
- Coordinating with law enforcement agencies to ensure that there are adequate resources available to support a program;
- Selection of appropriate technology requirements to record data based on legislation;
- Selection of vendors according to legislative requirements;
- Implementation of a pilot program that includes an effective public awareness campaign prior to active enforcement and issuing citations.

Many school bus stop-arm camera programs have proven to be successful at catching violators. Analysis of the existing programs provides useful information about program effectiveness. The following conclusions can be made:

- Bellevue's reported rate of illegal passing was much higher (2.7 times higher) when reported by stop-arm cameras as opposed to paper forms regularly completed by bus drivers. However, Arlington's passing rate as reported in surveys was found to be 11.6 times higher than when recorded by stop-arm cameras. These findings suggest that while bus drivers may be more vigilant as part of a one-day survey (as in Arlington), it is difficult to continue to watch for and report illegal passes. Therefore, stop-arm cameras may be more likely to catch violators than bus drivers using paper forms as a primary data capture method.
- The rate of illegal passing is much higher when reported by camera-equipped buses versus officer-observed passes (e.g., 15.8 times higher in Arlington). Officers must be on special operations monitoring a route or happen to witness an illegal passing whereas cameras are onboard and ready to record a pass at each stop along the route. Therefore, since officer observations of illegal passing are very rare, cameras are much more likely to catch violators than officers would be.
- Statistical analysis revealed:
 - A significant decrease in passing rates in Arlington after the policy announcement as compared to before the announcement of the policy, but no significant change in passing rates before implementation as compared to after implementation;
 - A significant decrease in passing rates in Bellevue between the pre-implementation phase and each year of the warning phase;
 - No significant changes in passing rates in Rankin.
- Future studies could more closely track each camera's installation date, bus route and number of stops, and camera outages/malfunctions, and maintain consistent data collection strategies. This could enable more accurate tracking of passing rates and enable school districts to accurately determine how effective stop-arm camera systems are in capturing and reducing violations.
- Generally, after drivers receive a citation, they do not receive additional citations.
- Stop-arm camera vendor data indicates that a typical school bus is illegally passed 6.1 times per month (47.9 times per school year), with no obvious cycle throughout the school year.

Although this study did not find clear evidence of the effectiveness of stop-arm camera systems in reducing passing violations, programs may be effective. A multi-year evaluation in which consistent public awareness campaigns, reliable citations, and high conviction rates may be required for camera

captured violations to result in discouraging violations. In addition, multi-years of camera captured violations without citations or warning would be needed for valid comparisons or statistically valid before-after violation rates. Before-after studies are, by definition, pseudo-experiments, and any change between before and after (e.g., vehicle miles traveled, population, roadway width) might offer an alternative explanation for changes in violation rates. Thus, other methods of comparing with and without stop-arm camera effects on violation rates would be desirable. These converging methods of evidence might come from comparison of rates between similar districts with and without public awareness campaigns and strict photo enforcement, or from multiple-baseline studies in which the same district issues citations based on camera detection in alternating years (one school year on, one off for a period of multiple years). Police enforcement captures the passes that are actually witnessed by an officer, and bus driver reports do not appear to be consistently able to capture every illegal pass given drivers' primary demands of driving and passenger safety. Therefore, for any comparisons to be reliable, the method of observing violations should be the same with and without photo enforcement.

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Appendix A: Public Information and Media Tracking

Study Site	News Outlet	Title	Date	Topic
Bellevue, Nebraska	WOWT 6 NEWS	Bellevue School Buses Are Watching You: New Cameras Catch Dangerous Passing Drivers	August 3, 2015	Bellevue Public School District working with camera vendor, REI. As many as 8 cameras installed/ bus. \$500 citation, 3 points on license. REI provided the cameras for free.
	Link: No longer available.			
Bellevue, Nebraska	School Transportation News	On-bus Camera System Catches Drivers Who Ignore School Bus Stop-Arms	September 16, 2015	76,000 illegal passes recorded in one day survey in USA in 2014. 13.68 million annually. REI designed system for Omaha Neb. 10 Bellevue buses have system. 2014, 163 violations over 500 undocumented. No students hit. Hope to reduce illegal behavior. Rear- and forward-facing HD cameras can capture up to 100 mph, works during rain or dark. Records license plates, uploads violations to school computer for officials to review.
	Link: https://stnonline.com/industry-releases/on-bus-camera-system-catches-drivers-who-ignore-school-bus-stop-arms/			
Bellevue, Nebraska	KEVT OMAHA 7 ABC	Bellevue Public Schools: Bus stop-arms not stopping drivers	August 14, 2017	12 buses with 8/cameras/bus. Data to be used in 2018 published report. 187 violations in 2016, 114 captured by camera. Also testing bus with 2 stop-arms, front & back. Only one citation issued in 2016. Goal is to raise awareness, not issue citations.
	Link: http://www.ketv.com/article/bellevue-public-schools-bus-stop-arms-not-stopping-drivers/12010895			

Study Site	News Outlet	Title	Date	Topic
Bellevue, Nebraska	Omaha <i>World-Herald</i>	Cameras Catch Motorists Ignoring Bellevue School Buses' Stop-sign Arms	August 14, 2017	187 violations, 94 would not be caught without camera. Violations would be higher, but there was a 3-month software malfunction. One \$500 citation given to offender. Warnings are issued instead of citations because legislation does not exist to cover this type of camera usage.
	Link: www.omaha.com/news/metro/cameras-catch-motorists-ignoring-bellevue-school-buses-stop-sign-arms/article_68e69480-d788-543f-8cc8-4b57ef88b4b6.html			
Arlington, Virginia	WJLA, Washington DC	Arlington School Buses get Cameras to Help Enforce No Passing Laws	July 10, 2015	CrossingGuard School Bus Stop-Arm Safety Camera Program implementation. Cameras mounted on sides of school buses. American Traffic Solutions provides the cameras. Offenders fined \$250. 1,828 illegal passing one day in VA in 2014. Warning period between July-September 7th. September 8th and forward fines will be issued.
	Link: https://web.archive.org/web/20150729195625/http://wjla.com/news/local/arlington-school-buses-get-cameras-to-help-enforce-no-passing-laws--115417			
Arlington, Virginia	Inside NOVA	New Arlington School-bus Cameras Beginning to Pick Off Violators	July 31, 2015	First 6 buses with cameras, issued 50 citations being mailed out. Warnings issued. After September 8th, fines of \$250. American Traffic Solutions installing cameras, will split revenue with county. Safety is primary concern. Cameras implemented for free, designed to capture offenses. Not all buses equipped with cameras, American Traffic Solutions will review infractions

Study Site	News Outlet	Title	Date	Topic
				and forward to police upon confirmation an infraction occurred.
	Link: www.insidenova.com/news/arlington/new-arlington-school-bus-cameras-beginning-to-pick-off-violators/article_a6877bae-377a-11e5-aa76-37f721e62096.html			
Arlington, Virginia	<i>Washington Post</i>	Arlington Tosses Tickets for Violations Caught by School Bus Cameras	October 23, 2015	Tickets are not enforced. County may refund already paid tickets. 995 citations issued by Falls church will not issue refunds. Case-by-case basis for refunding of violations. Program shut down, new programs delayed. Tickets originally could be mailed in 2011 bill, but bill was amended during legislation to remove mailing of tickets. Cameras are good deterrent, program should be reinstated, worry of more violations. Arlington issued 236 hand delivered citations in 2014-2015 school year. 216 mailed summonses. 31 paid \$250 fine. 185 tickets dismissed. May issue refunds to 31.
	Link: www.washingtonpost.com/local/education/arlington-throws-out-tickets-issued-from-school-bus-cameras-might-give-refunds/2015/10/23/74ae0a0a-79a4-11e5-b9c1-f03c48c96ac2_story.html?utm_term=.6245e6cd63ec			
Arlington, Virginia	WTOP	Smile for the Camera; School Bus Cameras Returning to Va.	June 11, 2016	Warning to drivers. School bus stop-arm cameras returning to Arlington County Public Schools. VA fine is \$250. 2015, 19 days of school = 216 violators. Over 20 buses will have cameras. 60% of citations reinvested for more cameras. Police review data before citations are sent, no point deductions.
	Link: https://wtop.com/dc-transit/2016/06/smile-camera-school-bus-cameras-returning-va/			

Study Site	News Outlet	Title	Date	Topic
Arlington, Virginia	Newsroom	School Bus Stop-Arm Enforcement Program Restarts on July 1 2016	June 16, 2016	Warning to drivers about restart of program. More than 20 buses equipped with cameras. CrossingGuard school bus stop-arm captures violations, sends to police for review, a citation of \$250 is issued.
	Link: https://newsroom.arlingtonva.us/release/school-bus-stop-arm-enforcement-program-restarts-july-1/			
Arlington, Virginia	Arlington Patch	Passing a School Bus: Cameras Will Now Catch Some Violators in Virginia	August 29, 2016	Informing drivers of the new program. Crashes are low, but danger is high. School bus drivers complained, finally being heard. Directions on how to act when around a stopped/stopping bus; slow down, stop 20 feet away, wait, once arm is retracted proceed. New rule, cameras are allowed to capture violations. Only some locations have them, Arlington, Fairfax, City of Falls Church. \$250 citations will be issued. New rule, citations can be mailed.
	Link: https://patch.com/virginia/delray/passing-school-bus-cameras-will-now-catch-some-violators-virginia			
Arlington, Virginia	Arlington Patch	Watch Out: Arlington School Bus Stop-Arm Camera Aims to Catch Violators	October 3, 2016	Warning, restart of the program October 3, 2016. Reinstated to improve child safety. Reinstated because new legislation exists to address citations. \$250 citation for violation of school bus stop-arm. Violations go to "violation processing system" are reviewed, then citations sent.
	Link: https://patch.com/virginia/arlington-va/watch-out-arlington-school-bus-stop-arm-camera-aims-catch-violators			

Study Site	News Outlet	Title	Date	Topic
Arlington, Virginia	FOX 5	Arlington Public Schools Restart Bus Camera Program	October 3, 2016	Warning to drivers of reinstated program. Legislation passed to approve mailed citations.
	Link: www.fox5dc.com/news/arlington-public-schools-restart-bus-camera-program			
Arlington, Virginia	New4 I-TEAM	More Drivers Charged With Illegally Passing School Buses	May 12, 2017	Description of the issue, and need for the program. I-Team captured footage of violations taking place. 154 drivers charged in Arlington from 2011-2013, more violations occurred than were issued citations.
	Link: www.nbcwashington.com/investigations/More-Drivers-Charged-With-Illegally-Passing-School-Buses-303364021.html			
Arlington, Virginia	LocalDVM.com	School Bus Stop-Arm Program fights to expand in Northern Virginia	August 28, 2017	Bus driver interviewed about school bus being passed when stopped. 19 ACPS have cameras, last school year 608 summonses to drivers issued. \$105,000 fines collected. 40% goes to school system 60% to vendor to run program. 6points not added to licenses. Some counties like Fairfax still fighting the program.
	Link: https://web.archive.org/web/20170829043955/http://www.localdvm.com/news/virginia/school-bus-stop-arm-program-fights-to-expand-in-northern-va/800332974			
Arlington, Virginia	Arlington Public Schools	School Bus Stop-Arm Camera Program FAQ	August 31, 2017	FAQs
	Link: www.apsva.us/transportation-services/school-bus-stop-arm-camera-program-faqs/			

Rankin County, Mississippi	MS NEWS NOW	Passing Danger: We Find Cars Passing Stopped School Buses	May 4, 2015	Description of the issue. Person died due to illegal school-bus passing. Bus equipped with GoPro to document issue.
	Link: https://web.archive.org/web/20150507205758/http://www.msnewsnow.com/story/28970249/passing-danger-we-find-cars-passing-stopped-school-buses			
Rankin County, Mississippi	WJTV12	Students Use Contest to Help Make Bus Rides Safer	January 20, 2016	South Jones Elementary 1 of 50 schools left in Samsung Solve for Tomorrow contest to improve student safety while crossing in front of a school bus. Trying to implement a stop-arm sign with a sensor to detect approaching vehicles which will sound an alert when the vehicle is seen alerting both student and driver to stop.
	Link: http://wjtv.com/2016/01/20/students-use-contest-to-help-make-bus-rides-safer/			
Rankin County, Mississippi	mpbonline.org	"Operation Stop" Urges School Bus Awareness, Safety	August 23, 2017	Description of the issue and Nathan's Law, which requires drivers to stop 10 ft. from bus, and allows for fines up to \$750 per incident and suspension of license.
	Link: www.mpbonline.org/blogs/news/2017/08/23/operation-stop-urges-school-bus-awareness-safety/			

Appendix B: Stakeholder Feedback

This section contains the paraphrased responses from stakeholders regarding their experiences with illegal school bus passing and the use of stop-arm cameras and enforcement programs. The stakeholder feedback described below was gathered through conversations with different stakeholders, rather than formal interviews. Therefore, comments by stakeholders were grouped by similar themes below and, in some cases, relevant responses were not provided by all three jurisdictions. Each bullet point represents a response from a different stakeholder, unless otherwise noted.

Feedback from Transportation Directors

Where did the idea to start a camera enforcement program originate?

- Not sure where it originated. We had an identified problem with drivers passing stopped school buses and the legislation provided a way for us to address the problem utilizing technology at no cost to the school district.
- Initiative of the school district's transportation director and a mutually beneficial partnership with a camera vendor. The vendor wanted to test new external cameras for illegal passing and we wanted a solution for reducing passes.
- A child was killed. Law was passed and we started school bus driver forms to report illegal passes to law enforcement. That effort became supplemented with a camera program initiated by the school district's transportation director.

What was the motivation to start a camera enforcement program?

- Problem with drivers passing stopped school buses
- An incident with a near miss in 2013.
- Child killed by an illegal pass.

Who were the biggest champions/supporters to start a camera enforcement program?

- Then deputy county manager, now county manager, was a driving force in getting the required county ordinance passed.
- School district transportation director.
- School district transportation director, mother of child killed, law enforcement.

Were there any opponents and was it feasible to address their concerns?

- The opposition raised was over privacy concerns by a vocal few. The data is held only as long as needed and then deleted.
- Legislators won't pick up on stop-arm cameras because their constituents are against them. Voters view the cameras as revenue generators and "big brother" watching. Legislators also get hung up on people saying they weren't the ones driving. Sample legislation provided by the transportation director includes language to get around this issue.
- No adverse reactions so far.

Did any policies or ordinances need to be developed or modified to implement the program?

- Required the county board to pass an ordinance.
- There is no supporting legislation to write tickets from cameras.
- No; the program was developed after Nathan's Law had passed.

Did the State or local jurisdiction already have another photo enforcement program in place (e.g., red light photo enforcement)?

- The county has a photo red light enforcement program; however, the program was not used as a model. State legislation for the two programs is different.

Were there other city/county departments, agencies, or organizations that you coordinated with to plan for the implementation?

- Yes. Police department, county manager's office, treasurer's office. We started working with them at the start since the program could not be undertaken without their assistance.
- Police department and county attorney.
- Law enforcement and the school board (for law enforcement and the school board (for budgeting/funds)).

How much time did it take to implement the program? (From the initial concept to when the first camera was fully operational on a bus.)

- It took approximately 6 months from start to the required ordinance being passed and establishing the required memorandum of understanding with the county. The required ordinance seemed to take the most time during the planning/implementation process and was about 3 to 4 months.

Did you need to procure additional resources beyond the cameras?

- No.
- Needed to install lot-wide WiFi.
- Memory cards and laptop (devoted solely for video).

Can you share the costs for implementing the program?

- There were no hard costs in implementing the program. The State allows a vendor to provide the equipment in return for a share of revenue.
- The cameras and supporting software were provided by a vendor at no cost in exchange for the school district allowing the vendor to install the cameras on their buses for testing purposes. The only cost to the school district was the installation of WiFi in the bus parking lot which cost \$18k.

What were the hurdles you encountered when planning for and implementing the program?

- The original State law was not written well. It caused suspension of the program at one point until new legislation could be introduced to correct the problem. We got over this hurdle by working with State representatives, other school districts, and our legislative liaison.
- Originally, the police chief indicated that he did not need legislation because the video from the bus cameras was evidence to permit citations. The law enforcement position changed as the

program was being implemented because they did not think citations issued from video would hold up in court. They instead planned to talk to drivers rather than send citations.

Do the cameras function well?

- Yes.
- Yes.
- Yes.

Do the cameras have any effect on how the stop-arm bars function or other bus components?

- No.
- No.
- No.

Does weather impact the functionality of the cameras?

- No.
- No.
- Climate affects the memory cards and wiring; heat causes warping. Headlight glare can be an issue so in those cases might only get the make and model of the vehicle.

How are the camera images when the time changes and it's darker in the morning or late afternoon?

- No problems.
- There are no issues.
- No issues.

How much maintenance have you found is required with the cameras?

- Some, but not a great deal. Handled by the vendor.
- The vendor currently takes care of all maintenance.
- Cameras are installed and maintained by our own mechanics and checked during typical inspections. Buses are inspected three times a year and anytime a bus is going on a field trip greater than 70 miles. Camera lenses need to be cleaned and are wiped off during inspection.

How much training was required for your staff and the drivers?

- Some training was required but very little. (example: can't wave drivers past your bus with the red lights activated, can't pass another bus with the red lights activated in the drop-off area, etc.)

Have you found that the number of drivers illegally passing buses has decreased since starting the program?

- Not yet.
- There have been 1,369 captured violations as of January 2018. We have not seen any repeat offenders in our school district. There has only been one repeat offender and he got a ticket.
- Not sure yet.

What have you been hearing from your bus drivers since implementing the program?

- Bus drivers did not like vehicles passing their stopped buses but in the past, there was little that could be done. They view this as a definite improvement.
- More violations are occurring on special needs buses because people don't see the school bus driver in his/her seat at the bus stop.

What have you been hearing from the community?

- The largest number of complaints received are from parents whose children's bus does not have a stop-arm camera.

Did you coordinate any media coverage to alert the community about the camera enforcement program?

- When the program first started, there was media coverage, emails to parents from the school system, and a 30-day warning period.
- There was some coverage at the beginning of the school year in 2016. Warnings were issued for the first 6 months of the school year and there was a public relations effort to advise drivers.
- Got the school district's public relations involved to raise awareness about the camera program.

Did the coverage include information about the dangers and/or laws against passing a school bus un/loading children?

- Not specifically. Most people know the dangers of passing a school bus loading or unloading children. They pass because they are in a rush or because of driver inattention.

What was the response to the media coverage? Do you think it had a positive influence?

- Yes

Do you think media coverage helps to reduce stop-arm violations in the short-term? Long-term?

- Yes, since the media coverage included a warning of a \$250 ticket if they passed a stopped bus.

Would you classify the program as a success so far?

- Yes. People are more aware of stopped school buses now than they were before the program. One noticeable difference is if in doubt they stop now.
- The cameras are so valuable because they catch what humans cannot.

If you could go back, what would you do differently?

- No
- Nothing?
- Wish we'd had plan from cradle to grave.

What advice would you give to another school system getting ready to implement a camera enforcement program?

- Reach out to other school systems that already have programs in place. They can advise you in a number of different areas of lessons learned (Example: when teachers wave parents past a stopped bus the parents receive tickets in the mail) that will prevent you from doing the same thing. In addition, they can provide copies of documents (example: M.O.U. with the police department for review of violations) that will make getting the program established in your jurisdiction much easier and quicker.
- Know what the software requirements are and if your network will support it. Also, check with your partners, such as law enforcement, as you begin developing a program. Think a program all the way through; including IT and who your partners should be.
- Make sure you get extra memory cards. Some will go out of service because they are evidence and others go bad. MAC will not run some camera software. Get a laptop that is devoted to just bus cameras. That way it won't interfere with your computer and you can take the laptop to court. Ensure you have the right cables (e.g., length depending on placement of the equipment). The more frames/second, the better. Play with the cameras/systems to get what you want. There are many different ways to do it and angles to capture. You need to have a good staff and work together. Debate until there is consensus. Make sure you understand what the court system/law enforcement needs when there is a violation.

Do you have any additional comments?

- We have shared lessons learned, documents, and general advice with a number of other school systems in the state (just this morning I was sharing information with another local school district) and several in other states. I wish I had access to this information when I began working on our program.
- Legislators want to know if the county attorney will stand behind a program. It would be helpful to have a toolkit that can be used to persuade legislators to pass supporting legislation. Cameras get images of the front and back of the vehicle so even if there is no front license plate, there will be video of the rear license plate.
- The bus must be at absolute zero mph to reduce the risk of the case being thrown out of court. Most passes occur in neighborhoods or apartment complexes. Side-mounted camera footage is used the most. Young kids will start running toward the bus as soon as they see it and the red lights are flashing.

Feedback from School Bus Drivers

Does it seem like there are fewer drivers illegally passing your bus since the camera was installed on the stop-arm bar?

- Not all buses have cameras. But when a stop-arm has a camera, people seem to notice the camera and now they stop. When a bus doesn't have a camera, people are oblivious. They seem to not notice the stop-arm.
- Buses are illegally passed every day. It happens most at stop-controlled intersections. There seems to be a difference with the cameras. One school bus driver says she was illegally passed less when she had a bus with a camera, but more illegal passing is occurring now that she has a bus with no camera. Motorists are starting to notice if a bus has a camera or not.
- Our law has had an impact on illegal passing. The penalties are non-negotiable.

Do you ever get any questions from parents or others about the camera?

- Parents are typically happy about the cameras once they find out what they are.

Does the camera give you additional security that drivers will stop when you're un/loading children?

- Drivers seem less likely to pass. But a camera won't stop a car – it will still hit the child.
- No.

Has the camera ever interfered with the stop-arm bar functioning correctly?

- No. It's not in the way; it's just doing its job.
- No and they don't take any extra lane space; but don't make them any bigger.

What do you like about having a camera installed on the stop-arm bar?

- It makes you so angry to see people going when students are crossing. Now you hope they will have to pay something. But the main objective is to get them to stop. If drivers don't know the camera is there, it might not make any difference.
- The cameras are doing what bus drivers can't. Watching the kids are their priority. They have forms to complete when they are illegally passed, but they don't always get the license plate number.

Do you have any concerns about the camera or its purpose?

- Drivers wish they could tell when a violator will get a ticket.
- Drivers were hesitant at first, but like them now. It holds them more accountable. The cameras also provide back-up to dispute any complaints.

Is there anything you would do differently? (e.g., placement on the bus, when the camera starts recording, etc.)

- No. It's in a good place.
- Most passes occur from the front of the bus and in our State there are no front license plates. Bus drivers write an affidavit, but the driver will not write one if he/she is not sure of the license plate.

Do you have any additional comments or feedback about using cameras installed on stop-arm bars to identify drivers illegally passing a bus?

Respondent A

- Drivers would appreciate an indication that the system is active and working. When a vehicle passes illegally, bus drivers cannot confirm that the photo enforcement captured the incident.
- Communication with bus drivers is important. Drivers would appreciate knowing how many people get tickets in a year.
- Bus drivers feel that if the system were more visible, it would be more of a deterrent. They'd like a notification – perhaps a sticker on the back of every bus that says, “PHOTO ENFORCEMENT OF ILLEGAL PASSING” or something similar. They're less interested in the penalties for passing than in the prevention of the illegal passes.

Respondent B

- Drivers need re-education. Motorists will say they were confused by the bus's tail lights, hazard signals, and flashing lights. Driver distraction is causing people not to stop. There are three reasons why drivers illegally pass:
 1. Drivers don't know what to do.
 2. Drivers don't care; they are in a hurry.
 3. Drivers are distracted (e.g., phone, putting on makeup, eating, etc.)
- School bus drivers can anticipate when a driver is going to pass.
- School bus drivers give plenty of notice to drivers. They don't just deploy the stop sign; they use their yellow lights as long as possible. School bus drivers will also use hand signals to make drivers stop. They will also maneuver their buses to help protect children. For example, they will position their bus towards the median in areas where there are high passing rates.
- There needs to be a consequence for illegally passing a bus. Fines make a difference.
- Cameras inside the bus can also catch activity outside of the bus.

Respondent C

- There needs to be a re-education of drivers.
- S/he can tell from the driver's face if s/he is going to pass. Most passes are deliberate. Drivers are commuters and know the buses have gone to door side stops only so they think nothing will happen if they pass.
- She will use the bus to slow people down and gives hand signals to the kids. She'll honk her horn and hold up her hand to drivers who look like they are going to pass (or are in the process of passing).
- Perhaps put bumper stickers on buses that read, “Do Not Pass” or “Illegal to Pass.” She would also like to see the DOT put up more signs that it's unlawful to illegally pass a school bus.
- The Mississippi Highway Patrol is starting to follow buses when they know their schedules.

Feedback from Law Enforcement

What do you need to see in camera footage to be able to issue a citation for illegally passing a stopped school bus while it's un/loading children?

- The stop-arm has to be fully extended, not moving. If the stop-arm is still moving, the judges dismiss those citations. We can see this in the still photos. The combination of the two still photos and the video covers all the needs.
 - We have to see the license plate. We have to be able to see the vehicle and see its location (not on the other side of a median). Check for someone waving a driver past (teachers do this in the schoolyard but they are not authorized to do that.) Judges throw out the citation if vehicles are being waved past.
 - Citations are also thrown out if the video doesn't clearly show how close the vehicle was. Judges want the vehicles to have some stopping distance.
- A clear image of the driver. Law enforcement is not comfortable writing a ticket when they didn't witness the offense and they cannot see the driver.
- Must be able to identify the vehicle and license plate number. [Law enforcement agencies] like having a good facial image. Also need video that shows the stop sign out and children un/loading. They will use license plate readers deployed in town to supplement the bus cameras.

Are the cameras giving you this information so that you can issue citations or do you need/want additional/clearer details?

- There is enough information. To make it easier, it would be nice if we could see where on the road the stop-arm is in relation to the passing vehicle. If the vehicle is 4-5 lanes away, it's hard to tell if the stop-arm/sign are fully extended when the car passes.
- It is better video than what we have in our police cruisers.
- They can manipulate frames from the video to get better images.

Do you find that you routinely cannot issue a citation because the video does not provide evidence that would stand up in court? Or are you typically able to issue a citation?

- Yes, the information is enough to issue.
- They are only issuing citations for repeat offenders at this point. With repeat offenders, officers want to talk the driver into an admission, which was the advice of the county attorney. For first offenses, they will call the registered owner to talk with him/her. If there is no phone number, they will visit the [owner] in person. [Owners] typically tell officers they didn't know what to do and admit they passed the bus. Some say the stop-arm came out late. With high school [drivers] the mom/dad [are alerted] first because the vehicle is registered in their name.
- Officers can write a ticket to the owner of the vehicle if they cannot determine who was actually driving.

Does it seem like fewer drivers are illegally passing buses since cameras have been installed and/or citations issued?

- We can't tell.
- Media coverage helps the most.

What challenges do you face with the camera enforcement program?

- There were difficulties in legalities initially. [Legislators] should have copied the red-light code, which is very thorough.
 - Going to court, judges tend to find the drivers guilty and then suspend the fines or part of the fines. Every court date they suspend at least a couple citations where they'll suspend all or part of the fine.
- Law permits officers to issue a citation to the owner of the vehicle if they cannot prove who was driving, however a judge is hard pressed to convict someone that may not have been the driver. Clear enough resolutions of the driver is the best scenario.

Are there benefits to law enforcement with a camera enforcement program?

- The program frees up officers and keeps officers safer because it minimizes traffic stops. The evidence is objective and it's hard to dispute. Prosecution is much easier.
- If an officer witnesses an illegal pass and cannot immediately stop the vehicle, it requires a secondary investigation which involves tracking down the driver.

What is the penalty/fine for illegally passing a stopped school bus that is un/loading children?

- It's a \$250 flat fine. There are no points and no court costs.
- Increased from \$250 to \$500.
- First offense is minimum \$350/maximum \$750 fine. Second offense is minimum \$750/maximum \$1500 fine, and license suspended for 90 days. There is a mandatory 3 days in jail if convicted but must be 100% sure that the person convicted was the driver. Stiffer penalties = need better evidence. Hitting a child is a felony.

Do drivers typically pay the penalty/fine or do they choose to go to court?

- Most court dates, someone sincerely believes they didn't pass. They come to court and they haven't watched the video.
 - The citation includes a link to the video so they can watch. This keeps a lot of people out of court.
 - Some dispute because the fine is high. \$250 is a high fine. For comparison, red light citation is \$50.
- Once drivers know there is video evidence, they will confess. Some will plead not guilty and hope for leniency in court. Even if drivers plead guilty, they must appear in court because of the required jail time.

How do judges typically rule when a driver appears for a citation that was issued using evidence from a stop-arm camera?

- There has been a learning period. With red light cameras, judges watch the video and find them guilty. With buses, there has been a learning period of what they are comfortable with. [The liaison] has learned where their comfort zone is and issues the tickets accordingly. This builds credibility with the judges. The judges are learning too – they used to pull out the books and look up the statute because it was new.

- Red light camera citations are cut-and-dried – it’s very clear what you can do. Bus citations were more ambiguous at first (see issues of stopping distance, etc.)
- Needs a test case to know what will happen in court. The outcome will depend on the judge.
- Judges typically want clarification on whether children were un/loading. They want to know that the elements of a crime occurred.

Additional Comments

Respondent A

- We don’t have the ability to issue warnings. When the vehicle doesn’t have stopping distance and the ticket would be thrown out, it would be nice to issue warnings.
- We had a call just yesterday from [another jurisdiction in the State.] We advised them to start slow. If you put them on all buses, you would be flooded with violations and you wouldn’t know yet what the judges want to see. We started with 19 buses. Don’t start with all the buses.
- Judges’ discretion is very local – would have to learn your judge’s preferences. So our experience might not translate to another jurisdiction.

Respondent B

- Law enforcement thinks about chain of custody so they can prove the video was not doctored.
- It would be easier for them if the State law required that non-moving violations go to the vehicle’s registered owner.
- They prefer that a third party identifies violations and issues citations.
- One idea the officers had was to add a flash to the camera so drivers immediately know they’ve been caught illegally passing the bus.
- Once the stop-arm is out, kids think it is safe and start crossing.
- Law enforcement does not want to be naming a law after a child hit by a car.

Respondent C

- Bus drivers are a big help. They can sometimes get the license plate number and they keep kids from getting off the bus if traffic is not fully stopped.
- There needs to be more education on what drivers should do when the yellow lights are flashing.
- Outreach needs to be constant. Social media is a direct way to have instant contact with people to raise awareness and educate drivers.
- The police chief talked about using signs on the buses to alert drivers of camera enforcement.
- There have not been any “big brother” arguments from the community.
- LED flashing lights distinguish between yellow and red better.
- Law enforcement will use the bus drivers, and to some degree video footage, to identify hot spots. Officers will then patrol these locations. If a bus does not have a camera, they will sometimes put an officer on a bus with a route that includes hot spots. He can then radio illegal passes to another officer in a patrol car.

Appendix C: Data File Contents and Coding Manual

This section describes each data set submitted to Toxcel during the execution of NHTSA Project DTNH2214C00391, *Evaluate Enforcement of Illegal Passing of Stopped School Buses*. A brief background is provided for each dataset, followed by detailed descriptions of each variable contained within. Variable names are presented as <Label> (<name-as-it-appears-in-data-file>).

The table below shows which variables appear in which data file, where 0s and 1s indicate each variable's absence or presence in each data file, respectively.

Data File	Jurisdiction	Period	School Year	Month	Month Imputation Flag	Survey Date	Time of Day	Hour	Bus ID	Citation ID	License ID	Driver ID	Vehicle Type	Source	Race	Sex	Age Group	Type	Pass	Road Type	Origin	Side	Submitted to PD	Amendment	Charge	Verdict	Sentence	Comments	
American Traffic Solutions	1	0	1	1	0	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Arlington Public Schools Bus Driver Surveys	0	1	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0
Arlington Traffic Court Proceedings	0	0	1	1	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0
Flowood Traffic Court Proceedings	0	0	1	1	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0
Bellevue Camera and Driver Observed Passes	0	0	1	1	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0
Rankin County Bus Driver Forms	0	0	1	1	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Rankin County Traffic Court Proceedings	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0
Richland City Traffic Court Proceedings	0	0	1	1	1	0	0	0	0	1	0	1	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	1	0

American Traffic Solutions Data

American Traffic Solutions, an Arizona-based transportation technology vendor, provided data on 130,913 passes observed by stop-arm cameras in 34 jurisdictions across the United States. Precise times and geospatial coordinates were provided, but stripped from the final data file for privacy purposes. Each record in this data file represents an observed pass.

Location (location)

The *Location* variable describes the city or county submitting the record. It is formatted as a text variable with 34 unique values. The table below shows the frequency of each value.

Location	Frequency
Cobb County	38,066
Atlanta Public Schools	28,166
Austin Independent School District	21,634
Clayton County Public Schools	8,956
Marietta City School District	7,751
Muscogee County	5,343
Decatur Board Of Education	3,334
Newton County	2,632
Athens-Clarke County Sd	1,845
Douglas County Sd	1,844
Bethel School District	1,513
Falls Church City Public Schools	1,316
Carroll County	1,271
Arlington County Public Schools	890
Washington County School District	876
Carrollton	858
Houston County School District	696
Fulton County Schools - Roswell	658
St. Marys County Md Public Schools	495

Location	Frequency
Mesquite Isd - City Of Mesquite	487
Roswell	393
Highline School District	361
Fulton County Schools - Alpharetta	359
Paulding County School District	312
Georgetown Isd	303
Marysville School District	159
Fulton County Schools - Milton	157
Mercer Island	69
Kaufman County - Crossing Guard	57
Alpharetta	49
Fulton County Schools - College Park	31
Mesquite Isd - City Of Balch Springs	12
Fulton County Schools - Union City	12
Fulton County Schools - Hapeville	8
<i>TOTAL</i>	<i>130,913</i>

School Year (school_yr)

The *School Year* describes the school year during which the observed pass occurred. All school years were assumed to begin on September 1 and conclude by August 31 the following calendar year. It is formatted as text with the pattern: “##### - #####” where the first “#####” represents the calendar year in which the school year begins, and the second represents the calendar year in which the school year concludes. The table below shows the frequency of each value.

School Year	Frequency
2012 - 2013	5,985
2013 - 2014	14,550
2014 - 2015	20,795
2015 - 2016	30,722

School Year	Frequency
2016 - 2017	58,861
<i>TOTAL</i>	<i>130,913</i>

Month (month)

The *Month* variable describes the date of the first day of the month in which the pass was observed. Actual dates are not provided so as to protect identities. It is formatted as “yyyy-mm-dd” and ranges from 2012-08-01 to 2017-06-01.

Hour (hour)

The *Hour* variable describes the hour during which the observed pass occurred, in local time. It is formatted as an integer and ranges from 4 to 24. Each value corresponds to a 24-hour clock where 0 represents 12:00 a.m. to 12:59 a.m., 1 corresponds to 1:00 a.m. to 1:59 a.m., etc. The table below shows the frequency of each value.

Hour	Frequency
4	2
5	176
6	4,968
7	24,372
8	19,049
9	271
10	163
11	368
13	1,235
14	16,837
15	26,748
16	28,640
17	5,123
18	1,557
19	360
20	5
21	3
22	2
24	1,034
<i>TOTAL</i>	<i>130,913</i>

It is not known why there are so many observations with *Hour* values greater than or equal to 17 (5:00 p.m. – 5:59 p.m.) given that most school districts send students home in the early afternoon although they may represent extracurricular activity trips. No points of contact were provided by crossing guard to inquire about this pattern.

Bus ID (bus_id)

The *Bus ID* variable describes the bus that was illegally passed. There are 1,043 unique values, formatted as *<location-code><sequential-bus-id>*.

License ID (license_id)

The *License ID* variable describes the license plate of the driver committing the illegal pass. Actual license plates have been anonymized to 5-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 127,991 unique values.

Warning (warning)

The *Warning* variable denotes whether the driver committing the illegal pass was issued a warning letter or a citation. Note that all records in this dataset are instances of illegal school bus passing; this variable indicates the subsequent action taken by the local jurisdiction. It is formatted as a single-digit indicator variable where a value of 0 indicates a non-warning (citation) and 1 indicates a warning. The table below shows the frequency of each value.

Warning	Frequency
0	129,151
1	1,762
<i>TOTAL</i>	<i>130,913</i>

Type (type)

The *Type* variable describes the type of action taken by law enforcement officers. Of the 130,913 passes observed, 129,151 resulted in citations (“CIT”); 1,762 resulted in written warnings (“WRN”).

Arlington Public Schools Bus Driver Surveys

The Arlington Public Schools System administered three surveys to its bus drivers during the 2014-2015 and 2015-2016 school years. Four days of data collection occurred in during the 2014-2015 school year and 3 occurred during the 2015-2016 school year. APS personnel informed Toxcel of several limitations to the data:

- The 2014-2015 surveys were conducted on 19 routes that were perceived to have the most passing violations based on anecdotal evidence while the 2015-2016 surveys were conducted on all routes.
- Drivers may not speak English as a first language.
- Driver literacy may vary.
- Driver perception of the stop-arm program varies, but anecdotal evidence suggests that they are motivated to acquire a camera on their bus routes. There was some concern that some drivers might overstate the incidence of illegal passes in order to acquire a camera for their route.

The file consists of 943 observations representing the responses from these surveys – some bus drivers reported zero passes on some of the survey dates and are indicated by a *Pass* value of 0. Such records are

important to keep to assess the rate of passing among bus drivers. Other bus drivers reported multiple passes; each of these passes is recorded as a separate record in this data file.

Period (period)

The *Period* variable denotes the time period of the survey response relative to the implementation of the school bus stop-arm legislation. It is formatted as a text variable with two values: “before” (310 records) and “after” (633 records).

School Year (school_yr)

The *School Year* describes the school year during which the observed pass occurred. All school years were assumed to begin on September 1 and conclude by August 31 the following calendar year. It is formatted as text with the pattern: “##### - #####” where the first “#####” represents the calendar year in which the school year begins, and the second represents the calendar year in which the school year concludes. The table below shows the frequency of each value.

School Year	Frequency
2014 - 2015	310
2015 - 2016	633
<i>TOTAL</i>	<i>943</i>

Survey Date (survey_dt)

The *Survey Date* variable describes the date of each survey response, formatted as “yyyy-mm-dd”. Four surveys were administered in the “before” period and three in the “after” period relative to implementation of the school bus stop-arm legislation. The table below shows the frequency of each value.

Period	Survey Date	Frequency
Before	2015-02-13	172
Before	2015-06-09	45
Before	2015-06-10	53
Before	2015-06-11	40
After	2017-03-28	230
After	2017-03-29	197
After	2017-03-30	206
<i>TOTAL</i>		<i>943</i>

Bus ID (bus_id)

The *Bus ID* variable describes the bus number of the survey respondent. Actual bus numbers have been anonymized to 2-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 148 unique values.

Pass (pass)

The *Pass* variable denotes whether each record is associated with a pass or a response indicative of no pass. Drivers reporting multiple passes on any one survey date have multiple records, one for each pass observed. Drivers who did not observe any passes have one record, with *Pass* = 0. Of the 943 records in this data file, 686 are associated with observed passes; 257 are associated with responses indicative that no pass was observed.

Time of Day (tod)

The *Time of Day* variable describes when the observed pass took place. Drivers indicated “AM” “PM” or “mid.” “AM” and “PM” values indicate the typical routes to and from school, respectively. “Mid” values indicate passes that occurred in the middle of the school day. The table below shows the frequency of each value, broken out by *Pass*. Those records with *Pass* = 1 and *Time of Day* = “NA” represent incomplete responses.

Time of Day	Pass	
	0	1
AM	0	380
mid	0	17
PM	0	284
NA	257	5
<i>TOTAL</i>	257	686

Origin (origin)

The *Origin* variable describes the longitudinal side of the bus on which the pass occurred, from the bus driver’s perspective. Drivers indicated “front” or “rear”. The table below shows the frequency of each value, broken out by *Pass*. Those records with {*Pass* = 1 and *Origin* = “NA”} or {*Pass* = 0 and *Origin* ≠ “NA”} represent incomplete or erroneous responses.

	Pass	
Origin	0	1
front	0	512
rear	1	173
NA	256	15
<i>TOTAL</i>	<i>257</i>	<i>686</i>

Side (side)

The *Side* variable describes the lateral side of the bus on which the pass occurred, from the bus driver’s perspective. Drivers indicated “left” or “right”. The table below shows the frequency of each value, broken out by *Pass*.

	Pass	
Side	0	1
left	0	650
right	0	36
NA	257	0
<i>TOTAL</i>	<i>257</i>	<i>686</i>

Arlington Traffic Court Proceedings

Toxcel acquired 1,090 traffic court proceedings for Arlington County from January 2012 to October 2017. Each record in this data file represents the proceedings from a single case involving an alleged illegal passing of a stopped school bus.

School Year (school_yr)

The *School Year* describes the school year during which the observed pass occurred. All school years were assumed to begin on September 1 and conclude by August 31 the following calendar year. It is formatted as text with the pattern: “##### - #####” where the first “#####” represents the calendar year in which the school year begins, and the second represents the calendar year in which the school year concludes. The table below shows the frequency of each value.

School Year	Frequency
2011 - 2012	96
2012 - 2013	110
2013 - 2014	230
2014 - 2015	222
2015 - 2016	234
2016 - 2017	186

School Year	Frequency
2017 - 2018	12
<i>TOTAL</i>	<i>1,090</i>

Month (month)

The *Month* variable describes the date of the first day of the month in which the pass was observed. Actual dates are not provided so as to protect identities. It is formatted as “yyyy-mm-dd” and ranges from 2012-01-01 to 2017-10-01.

Hour (hour)

The *Hour* variable describes the hour during which the observed pass occurred, in local time. It is formatted as an integer and ranges from 0 to 20. Each value corresponds to a 24-hour clock where 0 represents 12:00 a.m. to 12:59 a.m., 1 corresponds to 1:00 a.m. to 1:59 a.m., etc. The table below shows the frequency of each value.

Hour	Frequency
0	3
2	1
3	4
4	4
5	3
6	2
7	237
8	498
9	13
10	5
11	8
12	8
13	10
14	33
15	85
16	163
17	6
18	2
19	2
20	3
<i>TOTAL</i>	<i>1,090</i>

Type (type)

The *Type* variable describes the type of action taken by law enforcement officers. Of the 1,090 passes observed, 953 resulted in citations (“CIT”); 127 resulted in written warnings (“WRN”).

Citation ID (cit_id)

The *Citation ID* variable describes the citation number associated with each citation and warning. Actual numbers have been anonymized to 3-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 1,090 unique values.

Driver ID (driver_id)

The *Driver ID* variable describes the name of the driver receiving the citation/warning. Actual names have been anonymized to 3-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 1,089 unique values. These values can be used to analyze recidivism but the same name does not guarantee the same identity.

Amendment (amendment)

The *Amendment* variable describes any amendments an original charge may have undergone, formatted as text. Note that the original charge for all citations in the data file are for failure to stop for a stopped school bus, but some were amended to lesser charges. Those that were have an *Amendment* value other than “NONE”. The table below shows the frequency of each value.

Amendment	Frequency
AGGRESSIVE DRIVING	1
DEFECTIVE EQUIPMENT	22
FAIL TO OBEY HIGHWAY SIGN	34
FAIL TO OBEY TRAFFIC SIGNAL	1
FAIL TO PAY FULL TIME AND ATTN	116
FAIL TO YIELD TO PEDESTRIANS	1
IMPROPER DRIVING	137
IMPROPER PASSING	5
NONE	771
PASSING WHEN UNSAFE	1
SPEEDING (49 IN 30 MPH ZONE)	1
<i>TOTAL</i>	<i>1,090</i>

Verdict (verdict)

The *Verdict* variable describes the judgment in each citation. The table below shows the frequency of each value. Note that warnings (*Type* = “WRN”) have a value of *Verdict* = “NA”.

Verdict	Frequency
DISMISSED	25
GUILTY	742
GUILTY IN ABSENTIA	78
NA	127
NOLLE PROSEQUI	7
NOT FOUND	51
NOT GUILTY	12
PREPAID	37
TBD	11
<i>TOTAL</i>	<i>1,090</i>

Bellevue Public Schools Camera- and Driver-Observed Passes

From August 2008 to May 2017 there were 1,140 illegal school bus passes observed in Bellevue, Nebraska. During this time, some buses were outfitted with stop-arm cameras. Each record in this data file represents an observed illegal pass, whether recorded by the bus driver, the stop-arm camera, or both.

School Year (school_yr)

The *School Year* describes the school year during which the observed pass occurred. All school years were assumed to begin on September 1 and conclude by August 31 the following calendar year. It is formatted as text with the pattern: “##### - #####” where the first “#####” represents the calendar year in which the school year begins, and the second represents the calendar year in which the school year concludes. The table below shows the frequency of each value.

School Year	Frequency
2008 - 2009	104
2010 - 2011	41
2011 - 2012	68
2012 - 2013	165
2013 - 2014	180
2014 - 2015	213
2015 - 2016	185
2016 - 2017	184
<i>TOTAL</i>	<i>1,140</i>

Month (month)

The *Month* variable describes the date of the first day of the month in which the pass was observed. Actual dates are not provided so as to protect identities. It is formatted as “yyyy-mm-dd” and ranges from 2008-08-01 to 2017-05-01.

Hour (hour)

The *Hour* variable describes the hour during which the observed pass occurred, in local time. It is formatted as an integer and ranges from 0 to 20. Each value corresponds to a 24-hour clock where 0 represents 12:00 a.m. to 12:59 a.m., 1 corresponds to 1:00 a.m. to 1:59 a.m., etc. The table below shows the frequency of each value. Note that -99 denotes a missing value.

Hour	Frequency
3	5
4	4
5	2
6	29
7	266
8	98
9	30
10	28
11	60
12	25
13	9
14	39
15	249
16	121
17	8
18	5
23	1
-99	161
<i>TOTAL</i>	<i>1,140</i>

Bus ID (bus_id)

The *Bus ID* variable describes the bus number of the survey respondent. Actual bus numbers have been anonymized to 2-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 103 unique values. Note that missing observations are denoted with *Bus ID* = “MISSING”.

License ID (*license_id*)

The *License ID* variable describes the license plate of the driver committing the illegal pass. Actual license plates have been anonymized to 3-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 1,048 unique values. Note that missing observations are denoted with *License ID* = “MISSING”.

Origin (*origin*)

The *Origin* variable describes the longitudinal side of the bus on which the pass occurred, from the bus driver’s perspective. Of the 1,140 passes observed, 201 were from the front (*Origin* = “FRONT”), 129 were from the rear (*Origin* = “REAR”) and 810 records were missing this information (*Origin* = “MISSING”).

Road Type (*origin*)

The *Road Type* variable describes the road on which the pass occurred. Of the 1,140 passes observed, 466 took place on private roads (*Road Type* = “PRIVATE”), 673 took place on public roads (*Road Type* = “PUBLIC”) and one record was missing this information (*Road Type* = “MISSING”).

Source (*source*)

The *Source* variable describes the source of the information on the observed pass. Of the 1,140 passes observed, 154 were recorded on camera (*Source* = “CAMERA”), 947 were recorded by bus drivers (*Source* = “DRIVER”), 33 were recorded by both (*Source* = “BOTH”) and six records were missing this information (*Source* = “MISSING”).

Reported to PD (*to_pd*)

The *Reported to PD* variable indicates whether or not the observed pass was submitted to the local police department. Of the 1,140 passes observed, 196 were submitted (*Reported to PD* = “YES”), 170 were not submitted (*Reported to PD* = “NO”), and 774 records were missing this information (*Source* = “MISSING”).

Flowood Traffic Court Proceedings

Flowood, a city in Rankin County, conducted a search of its traffic court databases and provided Toxcel with all cases involving illegally passed school buses from September 1, 2015 to December 12, 2017. Each record in this data file represents the proceedings from a single case.

School Year (*school_yr*)

The *School Year* describes the school year during which the observed pass occurred. All school years were assumed to begin on September 1 and conclude by August 31 the following calendar year. It is formatted as text with the pattern: “##### - #####” where the first “#####” represents the calendar year in which the school year begins, and the second represents the calendar year in which the school year concludes. The table below shows the frequency of each value.

School Year	Frequency
2015 - 2016	3
2016 - 2017	32
TOTAL	35

Month (month)

The *Month* variable describes the date of the first day of the month in which the pass was observed. Actual dates are not provided so as to protect identities. It is formatted as “yyyy-mm-dd” and ranges from 2016-04-01 to 2017-05-01. Note that the documentation provided by Flowood indicated that the query included dates as early as 2015-09-01.

Citation ID (cit_id)

The *Citation ID* variable describes the citation number associated with each citation. Actual numbers have been anonymized to 2-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 35 unique values.

Race (race)

The *Race* variable describes the race of the driver cited for passing a stopped school bus. The table below shows the frequency of each value.

Race	Frequency
A (Asian)	2
B (Black)	6
U (Unknown)	3
W (White)	24
<i>TOTAL</i>	<i>35</i>

Sex (sex)

The *Sex* variable describes the sex of the driver cited for passing a stopped school bus. The table below shows the frequency of each value.

Sex	Frequency
M	18
F	17
<i>TOTAL</i>	<i>35</i>

Verdict (verdict)

The *Verdict* variable describes the judgment for each case. The table below shows the frequency of each value.

Verdict	Frequency
FAILED TO APPEAR	2
GUILTY	28
NOT GUILTY	1
REMAND	3
WARNING	1
<i>TOTAL</i>	<i>35</i>

Rankin County Bus Driver Forms

From 2010 to 2017 bus drivers in Rankin County were asked to record data each time they were illegally passed by another driver. Each record in this data file represents a single observed pass.

School Year (school_yr)

The *School Year* describes the school year during which the observed pass occurred. All school years were assumed to begin on September 1 and conclude by August 31 the following calendar year. It is formatted as text with the pattern: “##### - #####” where the first “#####” represents the calendar year in which the school year begins, and the second represents the calendar year in which the school year concludes. The table below shows the frequency of each value.

School Year	Frequency
2010 - 2011	<i>1</i>
2011 - 2012	14
2012 - 2013	17
2013 - 2014	8
2014 - 2015	18
2015 - 2016	113
2016 - 2017	23
Missing	7
<i>TOTAL</i>	<i>201</i>

Month (month)

The *Month* variable describes the date of the first day of the month in which the pass was observed. Actual dates are not provided so as to protect identities. It is formatted as “yyy-mm-dd” and ranges from 2011-03-01 to 2017-05-01. Note that seven records were missing this information and have empty *Month* values.

Hour (hour)

The *Hour* variable describes the hour during which the observed pass occurred, in local time. It is formatted as an integer and ranges from 0 to 20. Each value corresponds to a 24-hour clock where 0 represents 12:00 a.m. to 12:59 a.m., 1 corresponds to 1:00 a.m. to 1:59 a.m., etc. The table below shows the frequency of each value. Note that 78 records were missing this information and have *Hour* values equal to 99.

Hour	Frequency
6	22
7	27
8	1
13	2
14	21
15	33
16	16
18	1
99	78
<i>TOTAL</i>	<i>201</i>

Bus ID (bus_id)

The *Bus ID* variable describes the bus number of the survey respondent. Actual bus numbers have been anonymized to 2-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 92 unique values.

License ID (license_id)

The *License ID* variable describes the license plate of the driver committing the illegal pass. Actual license plates have been anonymized to 2-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 196 unique values.

Origin (origin)

The *Origin* variable describes the longitudinal side of the bus on which the pass occurred, from the bus driver's perspective. Of the 201 passes observed, 115 were from the front (*Origin* = "front"), 83 were from the rear (*Origin* = "rear") and three records were missing this information (*Origin* = "Missing").

Comments (comments)

The *Comments* variable describes any additional comments provided by bus drivers, formatted as free text. Such comments include:

- "Was loading. The stop-arm was out."
- "Vehicle stopped then sped through."

Rankin County Traffic Court Proceedings

Rankin County conducted a search of its traffic court databases and provided Toxcel with all cases involving illegally passed school buses from 2011 to the beginning of 2018. Each record in this data file represents the proceedings from a single case.

School Year (school_yr)

The *School Year* describes the school year during which the observed pass occurred. All school years were assumed to begin on September 1 and conclude by August 31 the following calendar year. It is formatted as text with the pattern: “##### - #####” where the first “#####” represents the calendar year in which the school year begins, and the second represents the calendar year in which the school year concludes. The table below shows the frequency of each value.

School Year	Frequency
2011 - 2012	1
2012 - 2013	1
2014 - 2015	4
2016 - 2017	10
2017 - 2018	5
<i>TOTAL</i>	<i>21</i>

Month (month)

The *Month* variable describes the date of the first day of the month in which the pass was observed. Actual dates are not provided so as to protect identities. It is formatted as “yyyy-mm-dd” and ranges from 2011-11-01 to 2018-01-01. Note that seven records were missing this information and have empty *Month* values.

Citation ID (cit_id)

The *Citation ID* variable describes the citation number associated with each citation. Actual numbers have been anonymized to 2-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 21 unique values.

Driver ID (driver_id)

The *Driver ID* variable describes the name of the driver receiving the citation/warning. Actual names have been anonymized to 2-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 18 unique values. These values can be used to analyze recidivism but the same name does not guarantee the same identity.

Charge (charge)

The *Charge* variable describes the charge levied against the driver. Of the 21 records in this data file, four represent drivers charged with interfering with the operation of a school bus (*Charge* = “INTERFERENCE WITH OPERATION OF SCHOOL BUS”) and 17 represent drivers charged with meeting or overtaking a school bus (*Charge* = “MEETING OR OVERTAKING SCHOOL BUS”).

Verdict (verdict)

The *Verdict* variable describes the judgment for each case. The table below shows the frequency of each value.

Verdict	Frequency
DISMISSED	1
GUILTY	10
NOLLE PROSEQUI	4
PENDING	1
WARRANT ISSUED	5
<i>TOTAL</i>	<i>21</i>

Sentence (sentence)

The *Sentence* variable describes the sentence for each case. The table below shows the frequency of each value.

Sentence	Frequency
\$200 FINE PLUS ASSESSMENTS	1
\$200 FINE PLUS ASSESSMENTS; 60 DAYS JAIL TIME SUSPENDED	1
\$200 FINE PLUS ASSESSMENTS; 60 DAYS JAIL TIME SUSPENDED; DEFENDANT TO ENROLL IN ANGER MANAGEMENT; 6 MONTHS SUPERVISED PROBATION	1
\$300 FINE PLUS ASSESSMENTS, 30 DAYS JAIL TIME SUSPENDED	1
\$350 FINE PLUS ASSESSMENTS	1
\$350 FINE PLUS ASSESSMENTS; DEFENDANT DID NOT APPEAR AT SECOND COURT DATE, WARRANT ISSUED FOR \$262 CASH OR \$3000 WITH BOND	1
\$380 FINE PLUS ASSESSMENTS; 30 DAYS JAIL TIME SUSPENDED FOR 6 MONTHS WITH GOOD BEHAVIOR	1
\$50 FINE PLUS ASSESSMENTS, 30 DAYS JAIL TIME SUSPENDED; DEFENDANT ALLOWED TO TAKE DEFENSIVE DRIVING SCHOOL	1

Sentence	Frequency
\$500 FINE PLUS ASSESSMENTS	1
\$750 FINE PLUS ASSESSMENTS; 30 DAYS JAIL TIME TO SERVE; \$1000 APPEARANCE BOND FOR APPEAL PURPOSE PLUS COST BOND	1
NONE	5
PENDING	6
<i>TOTAL</i>	<i>21</i>

Richland City Traffic Court Proceedings

Richland City, part of the Rankin County school district, conducted a search of its traffic court databases and provided Toxcel with all cases involving illegally passed school buses in 2016 and 2017. Each record in this data file represents the proceedings from a single case.

School Year (school_yr)

The *School Year* describes the school year during which the observed pass occurred. All school years were assumed to begin on September 1 and conclude by August 31 the following calendar year. It is formatted as text with the pattern: “##### - #####” where the first “#####” represents the calendar year in which the school year begins, and the second represents the calendar year in which the school year concludes. The table below shows the frequency of each value.

School Year	Frequency
2015 - 2016	9
2016 - 2017	12
<i>TOTAL</i>	<i>21</i>

Month (month)

The *Month* variable describes the date of the first day of the month in which the pass was observed. Actual dates are not provided so as to protect identities. It is formatted as “yyyy-mm-dd” and ranges from 2016-01-01 to 2017-06-01. Note that nine records were missing this information but have been imputed (see: *Month Imputation Flag*).

Month Imputation Flag (month_imp)

The *Month Imputation Flag* denotes records for which *Month* was imputed. The median time between provided court dates and arrest dates was 96 days. Court dates were provided for all records; for those nine records missing arrest dates, arrest dates were estimated as 96 days prior to court dates. Court dates were then aggregated to *Month* values for anonymity. Nine records were imputed (*Month Imputation Flag* = 1) and 12 were not (*Month Imputation Flag* = 0).

Citation ID (cit_id)

The *Citation ID* variable describes the citation number associated with each citation. Actual numbers have been anonymized to 2-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 21 unique values.

Driver ID (driver_id)

The *Driver ID* variable describes the name of the driver receiving the citation/warning. Actual driver license numbers have been anonymized to 2-byte, randomly generated arbitrary identifiers expressed as hexadecimal character strings. There are 20 unique values. These values can be used to analyze recidivism.

Age Group (age_grp)

The *Age Group* variable describes the age group (in 10-year increments) of the defendant. Values are formatted as text with the pattern “[<low>, <high>)”. The interval is closed on the <low> value and open on the <high> interval. For example, the *Age Group* “[20,30)” includes drivers greater than or equal to 20 years and less than (but not equal to) 30 years at the time of arrest. The table below shows the frequency of each value.

Age Group	Frequency
[10,20)	2
[20,30)	8
[30,40)	4
[40,50)	2
[50,70)	5
<i>TOTAL</i>	<i>21</i>

Race (race)

The *Race* variable describes the race of the driver cited for passing a stopped school bus. The table below shows the frequency of each value.

Race	Frequency
B (Black)	7
H (Hispanic)	3
W (White)	11
<i>TOTAL</i>	<i>21</i>

Sex (sex)

The *Sex* variable describes the sex of the driver cited for passing a stopped school bus. The table below shows the frequency of each value.

Sex	Frequency
M	15
F	6
<i>TOTAL</i>	<i>21</i>

Verdict (verdict)

The *Verdict* variable describes the judgment for each case. The table below shows the frequency of each value.

Verdict	Frequency
DISMISSED	1
GUILTY	18
NOT GUILTY	2
<i>TOTAL</i>	<i>21</i>

Sentence (sentence)

The *Sentence* variable describes the sentence for each case. The table below shows the frequency of each value.

Sentence	Frequency
\$350 FINE PLUS ASSESSMENTS; 5 DAYS COMMUNITY SERVICE INLIEU OF JAIL TIME DUE TO AGE	1
\$350 FINE PLUS ASSESSMENTS; 6 MONTHS JAIL TIME WITH 5 MONTHS AND 26 DAYS SUSPENDED, LEAVING 4 DAYS TO SERVE	1
\$350 FINE PLUS ASSESSMENTS; NO JAIL TIME DUE TO DEFENDANT BEING 17 YEARS OF AGE	1
\$750 FINE PLUS ASSESSMENTS; 30 DAYS JAIL TIME WITH 26 DAYS SUSPENDED, LEAVING 4 DAYS TO SERVE	2

Sentence	Frequency
\$750 FINE PLUS ASSESSMENTS; 6 MONTHS JAIL TIME SUSPENDED	1
\$750 FINE PLUS ASSESSMENTS; 6 MONTHS JAIL TIME WITH 5 MONTHS AND 23 DAYS SUSPENDED, LEAVING 7 DAYS TO SERVE	1
\$750 FINE PLUS ASSESSMENTS; 6 MONTHS JAIL TIME WITH 5 MONTHS AND 26 DAYS SUSPENDED, LEAVING 4 DAYS TO SERVE	2
NONE	3
UNKNOWN	9
<i>TOTAL</i>	<i>21</i>

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