UNIVERSITY OF MINNESOTA

OPTIONS FOR AUTOMATED SPEED ENFORCEMENTPILOT PROJECTS IN MINNESOTA WORK AND SCHOOL ZONES

FINAL REPORT

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Options for Automated Speed Enforcement Pilot Projects in Minnesota Work and School Zones

Final Report

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Executive Summary

Studies have shown that automated speed enforcement (ASE), when deployed in certain settings, increases roadway safety. Minnesota is one of the 36 states that do not use ASE. This is despite public opinion polling in Minnesota showing overwhelming public support for ASE in certain locations. This gap in Minnesota between (i) the safety benefits and strong public support for ASE in certain settings and (ii) state policy led to this study.

The purpose of the study was to investigate scenarios for an ASE pilot project in Minnesota. Work and school zones were selected as the target deployment location given the polling showing strong public support for ASE there and the experiences in other states showing that ASE is effective in reducing speeding in these areas. The aim of this study was to develop a pilot project blueprint to inform policymakers about the potential for such a project. The study included data and legal analysis, a literature review, and stakeholder engagement.

The study catalogues a number of the elements involved in designing an ASE pilot project in work and school zones and considerations involved with each such element. These elements include:

- Holding the driver, versus the vehicle owner, responsible for the violation.
- Civil versus criminal penalties.
- The extent automated warnings should be used.
- The penalties for non-payment of ASE fines.
- The role private contractors play in the ASE ticketing process.
- How evidence of an ASE violation is authenticated in court hearings.
- Law enforcement's role in operating the program.
- The allocation of ASE fine revenue.
- The goals of an ASE pilot project and evaluating whether goals are met.

While making choices about some of the design elements for an ASE pilot project are relatively straightforward, this study found many require weighing multiple and interdependent consideration that create difficult political and policy trade-offs. The result was that, even in an environment with apparent strong public support for ASE and strong evidence from other jurisdictions that ASE improves roadway safety, these tradeoffs can create substantial operational and political challenges to having an ASE pilot project in Minnesota at this time.

These operational and political challenges for ASE are not necessarily unique to Minnesota. Accordingly, they are surmountable as evidenced by the successful use of ASE in work and school zones in other states. But overcoming these challenges will first require the development of a general consensus among the relevant governmental stakeholders within Minnesota (i) that ASE can is a worthwhile tool for improving roadway safety despite the implementation challenges, and (ii) what in general an ASE program should look like operationally. Currently

this consensus does not exist. Developing such consensus will require, among other things, those policymakers that support ASE championing it as a valuable roadway safety tool, in order to provide the needed political and policy momentum to work through these operational and political challenges.

In the absence of such consensus, a wide range of design options for a Minnesota ASE pilot project needs to remain on the table. For this study, it meant the result was a catalogue of design elements for an ASE pilot project in work and school zones, rather than a set of preferred scenario

Chapter 1. Introduction

Studies have shown that automated speed enforcement (ASE), when deployed in certain settings, increases roadway safety by reducing the number of injury causing crashes. (1) The use of ASE is more widespread outside the U.S. than it is within the U.S. (2) Currently only 14 states and Washington D.C. employ ASE. (3)

Minnesota is one of the states that do not currently have ASE, as its use is effectively blocked by state law. (4) This is despite public opinion polling in Minnesota showing majority support for ASE generally and overwhelming public support for ASE in certain locations, such as road construction areas and school zones. (4)

This gap in Minnesota, between (i) state law and (ii) the safety benefits and strong public support for ASE in certain settings, led to this study. The purpose of the study was to investigate scenarios for an ASE pilot project in Minnesota. Work zones and school zones were selected as the target deployment location given the relatively stronger public support for ASE there, as well as the experience in other states showing that ASE reduces speeding in work and school zones. (5, 6, 7, 8, 9)

The aim of the study was to develop a pilot project blueprint to help inform state officials and lawmakers about such a project, and for state officials to use if such a project were approved by lawmakers. The study included data and legal analysis, a literature review, and stakeholder engagement. The study sought to identify the policy-level design elements of an ASE pilot project and the legal and practical considerations surrounding those elements.

Public opposition is generally cited as a main reason why ASE is not used in more states. In this light, this study provides an important case study. It shows some of the operational and political reasons why ASE does not move forward in a state where strong public support makes the state otherwise seem ripe for ASE.

The second chapter of this report describes the legal, political and roadway safety context for ASE in Minnesota. The third chapter provides the background information collected to generate the design elements for an ASE pilot project in Minnesota work and school zones. The next chapter identifies the challenges that emerged in taking the next step: identifying a set of preferred pilot design scenarios. The fifth chapter provides a summary of elements involved in a pilot ASE project in work and school zones and the issues surrounding those elements. The last chapter describes the lessons learned and possible next research steps.

Chapter 2. Context for ASE: Traffic Safety, Legality and Politics

A) Roadway Safety and ASE

As in other states, controlling speeding remains a key focus for improving roadway safety in Minnesota. (3) Between 2008 and 2010, illegal or unsafe speed was a contributing factor in 266 fatal crashes in Minnesota, resulting in 296 deaths and crash-related costs of over $360 million. (4) In 2010, driving at an illegal or unsafe speed was the driver behavior most frequently cited by law enforcement as a contributing factor to fatal crashes in Minnesota. (4)

ASE involves using roadside technologies, either fixed or mobile, that combine radar and image capturing capabilities. These technologies identify when a vehicle is speeding and take a picture of the vehicle's license plates and, if called for, a picture of the vehicle's driver. Speeding citations are then mailed to the vehicle's registered owner or, alternatively, the identified driver of the vehicle.

A relatively large body of research has identified ASE as one of the most effective tools for reducing speeding and improving roadway safety. (1, 2, 10) Importantly for this study, several jurisdictions have deployed ASE in school and work zones, with results showing a reduction in speeds in the ASE enforcement areas. (5, 6, 7, 8, 9) For example, in work zones subject to ASE, Illinois has seen a 4 to 8 mph reduction in the average speed of free-flowing cars and Maryland has seen the percent of vehicles exceeding the ASE enforcement speed limit fall from 7% to 1%. (5, 6, 7) Similarly, in a demonstration of school zone ASE in Portland, Oregon, average speeds fell 5% and the proportion of vehicles exceeding the speed limit by more than 10 mph fell by about two-thirds. (9)

Where employed, ASE is used as a complement, not a replacement, for traditional speed enforcement by police officers. ASE extends the scope of speed control efforts beyond the limited number of miles officers can patrol at any one-time, given their staffing and resource limitations. Moreover, ASE increases safety for law enforcement personnel by allowing safer speed enforcement in areas, such as construction zones, where it can be hazardous for officers to pull over speeding vehicles. Finally, ASE is less disruptive to traffic flows than the traditional approach of pulling a vehicle off to the side of a road, which can decrease a road's throughput.

Despite its advantages, ASE is used more widely outside of the U.S. (2) It is also used less in the U.S. than the other major form of automated enforcement: red-light cameras. (3) Neither ASE, nor red-light cameras, are currently used in Minnesota. (4)

B) Legal Environment

In many states, but not all, the use of automated enforcement needs to be authorized by state law. (2) While Minnesota does not currently have automated enforcement, it does have experience

with red-light cameras that helped shaped the current legal environment in the state for automated enforcement. (4)

In 2005, the City of Minneapolis initiated a red-light camera program. (11) Under the program, cameras identified vehicles that ran red lights and issued a citation to the owner of the offending vehicles (i.e., owner-liability). No state statutes specifically addressed the legality of cameras (or ASE). However, after 8-months, the state courts stopped the program. In *State v*. *Kuhlman*, the Minnesota Supreme Court stated the city's program was impermissible because it was preempted by state traffic laws. (12) Specifically the court said: (i) the program was not authorized by the state traffic laws; and (ii) it conflicted with state traffic law by imposing owner-liability when the legislature had not authorized owner-liability for red-light violations. In short, with its red-light program, the City of Minneapolis had done something the legislature had not approved and for which the city did not have the authority to do on its own.

Kuhlman had two principal consequences for ASE in Minnesota. First, it made clear there could not be any form of automated enforcement in Minnesota that used owner-liability without the legislature authorizing it. However, in this respect, *Kuhlman* did not significantly change the underlying legal landscape for ASE in Minnesota. Even before *Kuhlman* it was arguably apparent that, given the language of the existing traffic laws in Minnesota, any type of ASE would require legislative approval. (4)

The second consequence of *Kuhlman* was that it created a common perception that Minnesota's courts disfavored the idea of automated enforcement generally and that any form of automated enforcement would have difficulty withstanding legal scrutiny by the state courts. This view is largely out of step with the decision itself, which was relatively narrow and limited to the specific question of whether Minneapolis's program was preempted by existing state traffic laws. Nevertheless, the perception has endured and proved influential in the subsequent policy debates regarding ASE. Since *Kuhlman*, state law has not changed to permit either red-light cameras or ASE despite efforts to do so.

C) Political Background

As in many other states, in Minnesota there is a common view among journalists and policymakers that ASE, and automated enforcement generally, is controversial and unpopular with the public. (13) There are a number of voiced criticisms of automated enforcement, including:

- Automated enforcement is about government revenue generation, not safety.
- Automated enforcement represents an invasion of privacy and "big brother" style law enforcement.
- Drivers dislike the delay between the violation and receiving the ticket.

- Drivers prefer to have in-person contact with a ticketing police officer.
- Automated enforcement equipment make ticketing mistakes that are costly and time consuming for individuals to correct.
- Machines should not do police work.
- Automated enforcement takes jobs away from police officers. (2,4)

Despite these objections, public opinion surveys have generally shown a majority of Americans support ASE. (13, 14) Moreover, when ASE is limited to certain types of locations ASE may not be very controversial at all with most of the public. A 2011 national survey conducted by researchers at the University of Minnesota showed that ASE enjoys relatively strong public support. (13) Only when "all roads" are considered as deployment locations did the survey show support dropping below 50%. (13)

Researcher at the University of Minnesota found similar results in a 2012 public opinion poll of Minnesota residents that asked questions nearly identical to those asked in this national survey. (4) A majority (64%) believed ASE would be effective in improving road safety and a majority (56%) supported the idea of using ASE generally. (4) Further, support increased for using ASE in specific, limited locations. (Table 1) (4) More than three-quarters of respondents supported using ASE in construction and school zones. (4)

Table 1. Impact of Location on Support for ASE in Minnesota

Automated camera and radar devices to monitor speeding …	**"Very supportive"**	**"Somewhat supportive"**	**NET "SUPPORTIVE"**
In construction zones	57%	26%	**83%**
Near schools	59%	22%	**81%**
Where many have died	50%	27%	**77%**
Where many speed	39%	30%	**69%**
On all roads	16%	32%	**48%**

This similarity in the polling numbers for ASE in national and Minnesota surveys suggest that Minnesota may not be unique with respect to the public's view of ASE. (4) (Table 2) (Note, the national survey did not ask about the use of ASE in constructions zones.)

Table 2. ASE Location & Public Support: Minnesota vs. U.S. Public Opinion

Automated camera and radar devices to monitor speeding …	Minnesota Net "Supportive"	U.S. Net "Supportive"
Near schools	**81%**	**87%**
Where many have died	**77%**	**81%**
Where many speed	**69%**	**75%**
On all roads	**48%**	**43%**

These polling results led researchers at the University of Minnesota to develop a strategy for moving forward with ASE in Minnesota. (4) The strategy recommended first proceeding with an ASE pilot project in work and school zones, given that these were the deployment areas for which there was apparently the most public support. This study builds up that strategy to investigate the possible design of ASE pilot projects in Minnesota school and work zones.

Chapter 3. Scenario Development: Step One - Information Collection

This study was initiated to develop the preferred scenarios for an ASE pilot project in work and school zones, in order to educate and provide guidance to policymakers and other stakeholders. The study's scenario development process generally involved two-steps. The first step was the collection of background information to identify project design variables and options with respect to these variables. The second step was a narrowing of these options into a discreet set of preferred scenarios. Input from a panel of stakeholders and academic experts was collected in several rounds to provide feedback both on the information collection and to look for consensus on the preferred scenarios.

This section outlines the first step in the scenario development process: background information collection and the identification of scenario variables and options. Three main topics areas are covered: (A) deployment location; (B) legal structure; and (C) operational elements.

A. Deployment Locations

Experience in other jurisdictions has shown that ASE is most successful and accepted when it is deployed in an area with an identified crash problem related to speeding. (2) Accordingly, the first step was: (i) quantifying, to the extent possible, the extent of a crash problem in Minnesota's work and school zones; (ii) assessing the extent to which that problem is attributable to speeding; and (iii) investigating spatially where reducing speeding with ASE may be the most effective in decreasing crashes in work and school zones. This subsection first examines work zones and then school zones.

1) Work Zones

a) Work zone crashes. An original analysis of state work zone crash data was undertaken. (15) From 2004 to 2011, there were on average 1,820 work zone crashes per year in Minnesota. During this period, work zone crashes represented 2.3% of all crashes in the state. Of the work zone crashes during this period 0.4% were fatal, 30% were injury causing, and 69.6% were property-damage-only (PDO). This is nearly the same crash-type distribution seen for crashes on all roads suggesting that, in terms of crash types, work zones are no safer than Minnesota roads generally. (Table 3)

Table 3. Work Zone and All Road Crashes (2004-2011)

	Work Zones		All Roads	
	No.	**% of total**	**No.**	**% of total**
Fatal Crashes	57	0.4%	3,428	0.5%
Injury Crashes	4,369	30.0%	194,073	30.4%
PDO Crashes*	10,130	69.6%	440,619	69.0%
Total Crashes	14,556		638,120	
Fatalities	75		3,785	

*Property Damage Only (PDO); Data source: MnDOT

With regard to trends, in absolute terms between 2003 and 2011, the number of severe injury crashes in work zones generally declined, while the number of fatal crashes held relatively steady. (Figure 1).

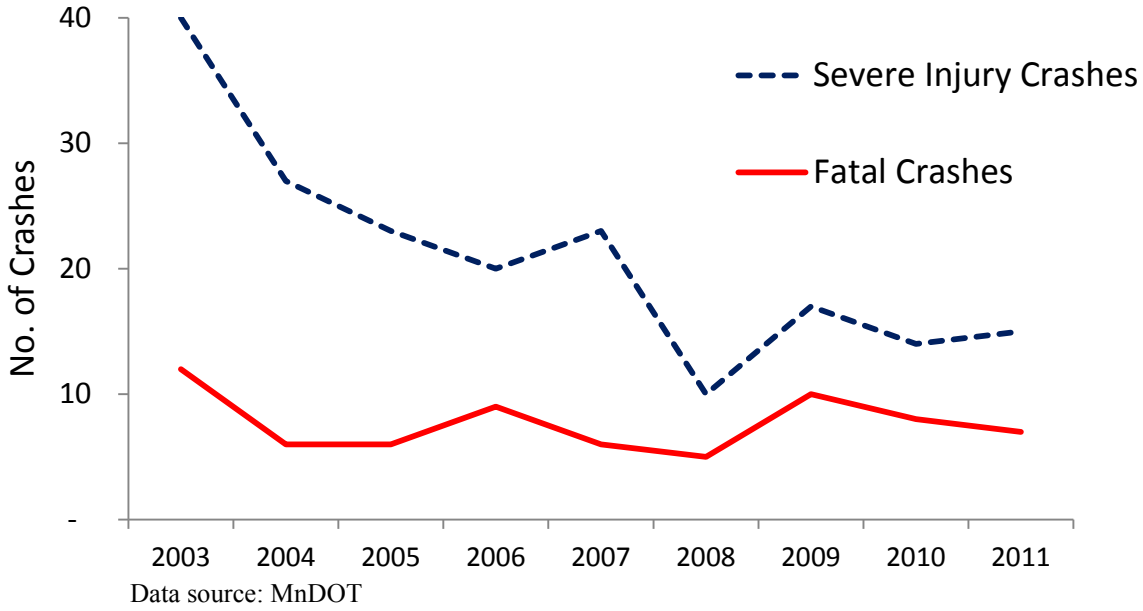
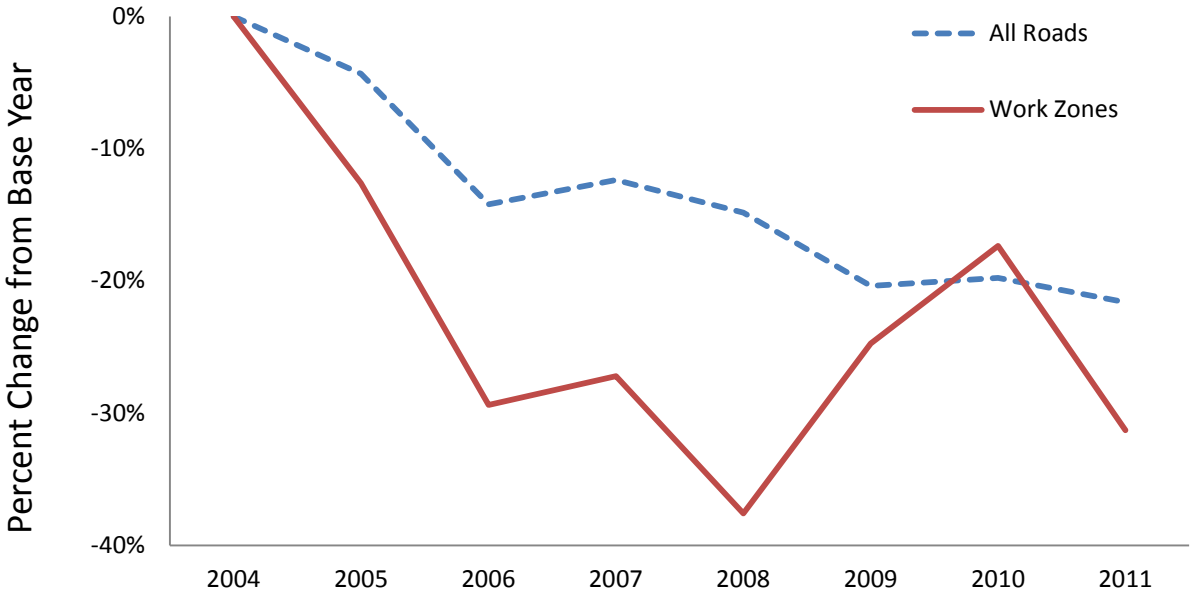


Figure 1. Work Zone Crash Trends: Fatal & Serious Crashes (2003-2011)

In recent years, Minnesota has seen a steady decline in the per vehicle-miles-travelled (VMT) crash rate on all roads. Between 2002 and 2011, the VMT crash rate on all roads fell from 175 to 127 per 100 million VMT. (16) Likewise, the fatality rate on all roads has fallen from 1.21 to 0.65, per 100 million VMT. (16) This compares to the national average fatality rate of 1.1, per 100 million VMT, in 2011. (17) This decline in Minnesota has been attributed, among other things, to increased enforcement of drunk-driving laws and demographic changes. (16)

Data on the VMT in work zones was not available in order to answer directly the question of whether work zones are more dangerous than non-work zone areas, per VMT. If the ratio of VMT in work zones to the VMT on all roads is assumed to have remained constant from 2004 to 2011, then the crash rate in work zones has generally fallen to a greater degree than the decline in the crash rate on all roads. (Figure 2)

(Base Year = 2004)



Data source: MnDOT

Figure 2. Percent Change in Crashes Per VMT: Work Roads v. All Roads

Worker safety is also a concern in work zones. The data shows workers were present in at least one-third of all work zones crashes in Minnesota. Similar to other states, though, the vast majority of fatalities in Minnesota work zone crashes involve non-workers (95%, 2003-2011). (30) Data on worker injuries due to crashes was unavailable.

Generally, the data indicates there is a statewide crash problem in Minnesota work zones worth addressing. While the crash rate per VMT appears to be falling in work zones, the absolute number of fatal crashes per year has held relatively steady in recent years. Data limitations prevented quantifying the relatively safety of work zones per VMT, as compared to all roads. However, when crashes do occur in work zones, the severity of the crashes has the same distribution as those on all roads.

b) The role of speeding in work zone crashes. Table 4 shows the relatively frequency of contributing factors cited for work zone crashes. (12) For all work zone crashes, speeding is the third most frequently cited factor, behind driver distraction and following too closely. However,

the results show that the more severe the crash, the importance of speeding increases. For example, in fatal crashes the importance of speeding as a contributing factor increases, and is second only to driver distraction. In addition, the two factors cited more frequent than speeding -- driver distraction and following too closely -- are speed related. That is, as speed increases so too do the dangers of driver distraction and short following distances.

Table 4. Percent of All Contributing Factors Cited
In Work Zone Crashes (2003-2012)

Contributing Factor	All Crashes	Fatal Crashes	Injury Crashes
	(N=26,224)	(N=107)	(N=8,145)
Driver inattention or distraction	27%	27%	29%
Following too closely	19%	2%	17%
Illegal or unsafe speed	12%	21%	14%
Failure to yield right of way	8%	4%	8%

Data Source: MnDOT

Accordingly, while the contributing factor data does not point to speeding as the leading cause of work zone crashes, it does support the position that it is a substantial contributor.

c) Spatial Distribution of Work Zones. Work zones occur on a variety of different types of roads and the zones may stretch for a number of miles. The statewide crash data was analyzed to determine which road types had the most work zone crashes and where within work zones did crashes occur. (15)

From 2003 to 2012, the largest percentage of work zone crashes (41%) as well as the largest percentage of fatal crashes (36%) occurred on interstate highways. State trunk highways were also notable in this regard, with 16% of work zone crashes and 26% of fatal crashes. Data on the

amount of work zone miles on particular road types was not available. So these figures represent the simple, unweighted percentage of all work zone crashes that occurred on a given road type.

The location of crashes could not be tied to specific types of road construction work. However, officer notes in crash reports reflected that a majority of crashes occurred in the construction activity area (53% of all crashes, 58% of interstate crashes), as opposed to warning, transition or termination areas. In addition, lane closure was the type of work most often associated with crashes (35% of all crashes, 36% of interstate crashes).

These results indicate that the existing crash data can inform the options for where to deploy ASE equipment in a work zone pilot. Specifically, interstate work zones involving lane closures, would be a target location, with the speed reduction efforts focused within the work activity areas.

Overall, the statewide crash data indicates that speed-related crashes in work zones are an important problem and one that ASE could potential help address.

Buttressing this quantitative assessment is the normative consideration that policy makers should strive to make work zones safer than roadways generally, given the presence of vulnerable construction workers working in close proximity to vehicles traveling at high speeds. This is part of the justification in Minnesota for the current lower speed limits in work zones and the higher speeding fines. (18) It is also part of the reason that some jurisdictions have adopted "zero tolerance" for speeding in construction zones. (19) Further, those states that have expanded ASE deployment areas to include work zones point to this normative argument, in addition to the quantitative case for work zone ASE.

2) School Zones

a) School zone crashes. An original analysis of statewide crash data with respect to school zones was undertaken for the years 2002 to 2011. (20) During this period there were a total of 242 reported school zone crashes. None of these crashes were fatal, while 34% involved injuries and 66% were PDO crashes. There was an average of 9 injury crashes per year and a total of 4 serious injury crashes for the entire 10-year period. From 2004 to 2011, school zone crashes represented 0.03% of all crashes in the state.

With regard to trends, in absolute terms between 2002 and 2011, the number of injury crashes in school zones has generally declined though not consistently. (Figure 3)

Figure 3. All Injury Crashes in School Zones

As with work zones, data on VMT in school zones was not available to address the question of whether school zones are comparatively more dangerous than non-school zone areas, per VMT. If the ratio of VMT in school zones to the VMT on all roads is assumed to have remained constant from 2004 to 2011, then the crash rate in school zones has fallen substantially more than the decline in the crash rate on all roads. (Figure 4)

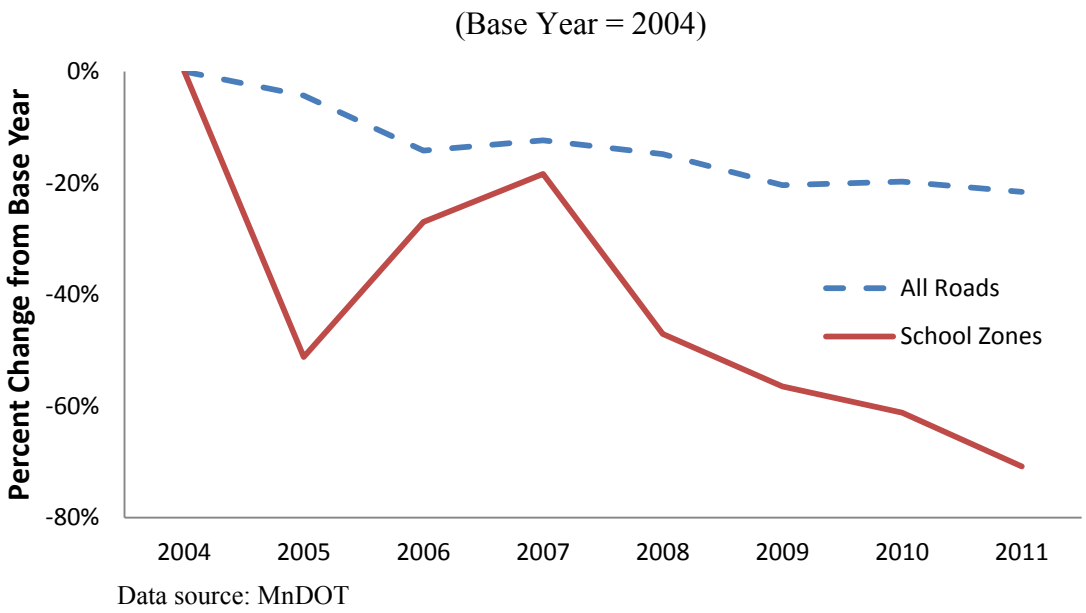


Figure 4. Percent Change in Crashes Per VMT: School Zones v. All Roads

The lack of a consistent year-on-year trend in Figure 4 is most likely attributable to the relatively small number of reported school zone crashes, such that an increase in only a few crashes in a given year can create a spike in the year-on-year crash rate.

Overall, the data indicates there is a relatively small number of reported school zone crashes, particularly serious injury crashes, and the number and rate of school zone crashes appear to be declining over time. The small number of crashes may, in part, be reflective of limitations with the data. Crashes are only noted as being in school zones in the statewide crash data if the reporting officer notes the presence of a school zone in the crash report. Thus the data may not reflect the actual scale of the crash problem in school zones. Nevertheless, this data indicates that school zone crash problem is on a much smaller scale than the work zone crash problem.

b) The role of speeding in work zone crashes. Table 5 shows the relatively frequency of contributing factors cited in the officer reports for school zone crashes. For crashes involving injuries, speeding is the fourth most frequently cited factor, behind driver distraction, failure to yield and following too closely. Further, the relative importance of speeding does not change depending on the crash type. Thus, the contributing factor data does point to speeding as factor in school zone crashes but not as a leading or primary cause.

Table 5. Percent of All Contributing Factors Cited In School Zone Crashes (2002-2011)

Contributing Factor	All Crashes	Injury Crashes	PDO Crashes
	(N=249)	(N=89)	(N=160)
Driver inattention/distraction	24%	28%	22%
Failure to yield right of way	14%	25%	8%
Following too closely	13%	10%	14%
Illegal or unsafe speed	10%	10%	10%
Weather	8%	4%	10%

Data Source: MnDOT

c) Spatial Distribution of Work Zones. Unlike with work zones, limited information could be drawn from the crash data regarding where in school zones crashes occur or on what type of roads they occur. Over three-quarters of all school zone crashes occur on county highways (29%), municipal highways (29%) and municipal roads (23%). It follows from this that in roughly three-quarters of the crashes (78%), where the crash report notes the road design, it was a two-lane road with traffic going in both directions. Data was not available regarding the road types on which schools are located in Minnesota. So these figures represent the simple, unweighted percentage of all school zone crashes that occurred on a given road type. In other words, they do not provide information on whether crashes are more likely to occur on one road type or other, controlling for the number of schools on each road type.

Overall, the state crash data provides limited information on the speed-related crash problem in school zones. This means, to the extent there is a quantitative case for ASE in Minnesota school

zones, it is likely going to be a case driven by crash or speeding problems at particular local sites, rather than as a statewide problem. This study did not have access to sufficient local data to identify such sites.

As with work zones, beyond the quantitative evidence, there is also a normative argument that supports ASE in school zones. The safety of children generally and students while at school is a public priority. School zones are by definition areas subject to periodic high levels of traffic activity that coincide with relatively high concentrations of school-age pedestrians, vehicles with school-age passengers, and in the case of high-schools, school-age drivers. (9) School-age pedestrians in particular are comparatively more vulnerable due to their lower awareness of risk and impulsive behavior. (9) The lower speed limits in school zones reflect that these considerations have led to policy responses. (18) Thus, policymakers may make a judgment that it is appropriate to have ASE in school zones in order that all available tools are used to increase the safety of school zones. Several states have made this determination and deployed ASE in school zones. (21)

B) Legal Structure

The experience in a number of jurisdictions, including Minnesota, shows automated enforcement programs need solid legal footing. (2) In Minnesota, as a first step, this would require legislative authorization of any ASE program, including a pilot project. Beyond simply authorizing the project, the legislation would need to create the legal structure for the enforcement component of the program. (4) Doing so raises a host of legal issues, but most of the issues are driven by two main questions: (i) Who is responsible for the ASE violation? and (ii) What is the nature of the penalty?

1) Responsibility for Violation

There are two options for who is responsible for an ASE violation: the driver of the vehicle (driver-liability); or the owner of the vehicle (owner-liability). (2) In a driver-liability system, the ASE equipment captures an image of the driver, the vehicle and its license plates, and a written citation is mailed to the driver. In an owner-liability system, images of only the vehicle and its license plates are captured, and the citation is mailed to the registered owner of the vehicle.

Owner-liability systems are considered easier to administer. Among other reasons, this is because they do not require the back-office work of matching the image of the driver with a photo from the driver license's database. They also generally result in a higher rate of tickets issued for detected violations. Further, owner-liability systems raise less privacy concerns because the ASE equipment is not taking a picture of individual drivers. For these reasons, most jurisdictions with automated enforcement use owner-liability systems. (4)

2) Nature of the Penalty

While owner-liability is easier to administer, it raises due process concerns about holding the vehicle owner liable without evidence that the owner was the one actually operating the vehicle at the time of the violation. (4) Jurisdictions with owner-liability typically address these concerns by making the penalties for ASE violations civil, rather than criminal. (4) That is, they make ASE violations similar in legal nature to those for non-moving violations, such as a parking ticket (as opposed to being equivalent to a conventional speeding ticket). Generally this means the penalties are only a monetary fine and the violation is not recorded against an owner's driving record, though there may be implications for the driver's license and vehicle registration if the fine goes unpaid. Courts in a number of jurisdictions have held that automated enforcement programs with only civil penalties do not violate constitutionally protected due process. (22)

Driver-liability systems, because they result in identifying the driver, generally avoid these due process problems. (4) As a result, they can impose the same type of penalty as a conventional speeding ticket.

In sum, owner-liability systems, while less costly and typically with higher citation rates, generally require lesser civil penalties for a violation. On the other hand, driver-liability systems are more difficult to administer, raise greater privacy concerns, and typically result in lower citation rates, but do allow for imposing the same penalties as those for a conventional speeding ticket.

C. Operational Elements

There are a multitude of operational components to an ASE pilot project, ranging from how vendors are compensated to the threshold speed over the speed limit that triggers an ASE violation. There is a relatively large literature discussing the relative advantages and disadvantages of various operational elements for ASE programs. (2,14) For this study, those components most relevant to Minnesota's circumstances, and to pilot projects in school and work zones, were cataloged based on, among other things, the experiences in other states. Chapter 5 provides a more complete list of the issues cataloged. For purpose of this subsection, focus is given to those operational components that warrant a broader discussion than provided in the tables in chapter 5, either because they are potentially controversial or present unique considerations for Minnesota.

1) Type of ASE units

Since construction zones are impermanent, fixed ASE units (i.e., units mounted to roadside infrastructure) are generally not suitable. Thus, for work zones the choice of ASE unit type is generally between unmanned mobile units and manned vehicle-based units.

Unmanned mobile units require less roadside shoulder space for deployment and save on staff operation time. However, those jurisdictions currently using ASE in work zones employ manned in-vehicle units. (6, 7, 23) They do so for the increased mobility within and among work zones, along with the reduced vandalism risk. Manned units also offer the advantage in states, like Minnesota, where under state law the work zone speed limits are only in effect when workers are present. (18) With manned vehicle units the ASE operator can confirm workers are present at the time of the violation.

A key question with manned units is by whom they are operated. Some states have the vehicles operated by employees of the ASE vendor. Other states require that the vehicles be operated by a police officer. The decision between the two approaches can be influenced both by cost considerations as well as labor relations with law enforcement unions.

Because school zones are set locations, fixed infrastructure-based units are an option in addition to unmanned and manned mobile units. However, in school zones fixed units have the disadvantage that, if they are just enforcing the school zone speed limit, they are only operational during those limited times when the school speed zone is effect. In Minnesota, school speed zones are only in effect when children are present. Thus, the short operation hours at a single locational may not justify the investment in and lack of flexibility of a fixed ASE unit, particularly during the limited duration of a pilot project. In this regard, mobile units offer the advantage of being able to relocate to different school zones during the course of the day, particularly in communities that have staggered school start and end times.

In addition, for school zones manned units also offer the advantage of the operator being able to visually confirm when children are present, since in Minnesota the school speed zone limits are only in effect when students are present. (18) Alternatively, such confirmation can be provided by the ASE equipment itself. Technology is available by which ASE units can take pictures that confirm the presence of children at the time of the ASE violation.

2) Automated Warnings

By definition, ASE programs issue citations that carry some type of penalty. Many jurisdictions though will issue automated written warnings with no penalty for an initial grace period when ASE units are first deployed in an area. (2) It appears, though, no U.S. jurisdiction operates an ASE program with written warnings as a principal method for controlling speed. Nevertheless, the experience with automated speed warning signs suggest that automated written warnings could be successful in changing driver behavior, though it is unclear to what degree they are effective as fines. (24)

As a result, for the pilot project the use of automated warning for more than initial deployment periods is an option for consideration and study during the pilot. The use of warnings, as opposed to citations, would solve a number of the legal and political obstacles with ASE. On the other

hand, it presents challenges in that one of the major advantages of ASE is that it can often be operationally self-funded through fine revenue.

3) Intra-governmental cooperation

The deployment of ASE in work and school zones necessarily involves a number of governmental agencies and branches, including law enforcement, the courts, the state transportation department, local government, and school districts. These organizations would play an essential role in the success of an ASE program, even if it was just a pilot project. The experience with ASE in other jurisdictions has shown that deliberate and organized cooperation among the many governmental actors involved is critical. (2) To address this need for cooperation, a standing inter-governmental task force may be needed to facilitate the planning and coordination of ASE deployments.

Given these coordination considerations, notably a pilot project in work zones can be structured to involve fewer governmental actors than a school zone pilot project. For example, if a work zone pilot project were conducted on just interstate highways, conceivably the government branches or departments directly involved could be limited to include the judiciary, the Department of Transportation (MnDOT), and the Department of Public Safety (DPS). In contrast, a school zone pilot would necessarily need to also involve local government, local law enforcement and school administrators.

4) Role of ASE vendors

Private companies are involved in ASE programs because they provide necessary hardware, software and technical expertise. The vendor's involvement can range from delivering a turn-key ASE program to only being involved in select portions of the program.

The involvement of a private company in speed enforcement can be controversial with the public. This is particularly the case if the company has an actual (or perceived) economic incentive to issue more tickets and/or influence where ASE units are located for economic rather than safety reasons. Further, the involvement of a private vendor in an ASE program can raise privacy concerns given that the vendor may have access to personally identifiable data about speeding violations and the location of vehicles and/or drivers.

For these reasons, in order to increase acceptance of an ASE program among the public, the program's design must be sensitive to the scope of a vendor's involvement, the compensation terms of the vendor's contract and the data privacy aspects of using a private vendor. Options for dealing with these issues including having vendors on flat-fee contracts with contract terms that give public agencies complete control over deployment locations and that subject vendors to the same data privacy obligations as public agencies.

5) How evidence for ASE is authenticated in adjudication hearings

Like conventional speeding tickets, citations from ASE equipment may be contested in court by the person against whom the ticket is issued. For evidence from the ASE equipment to be admissible in court to establish the violation, the evidence must be authenticated in the proceeding in accordance with the rules of evidence. (25) In the authorizing legislation for ASE, the legislature can set guidelines for the courts regarding the admissibility of evidence from ASE devices, including addressing issues of evidence reliability and accuracy. (26) A key question for these guidelines is who may authenticate the evidence from ASE equipment in court proceedings. Can an employee of the vendor do so? Does a law enforcement officer need to do so? Or can the evidence be self-authenticating (i.e., not require the testimony of an individual for authentication)?

In part, the answer to these evidentiary questions follows from the type of legal penalty set for an ASE violation (i.e., criminal or civil). But there are also important operational considerations for how these authentication questions are answered. Chief among these, from a cost perspective, is whether an officer or vendor representative must appear at the court proceeding. Relevant for these issues is that the experience in other states suggests that the rate at which tickets are contested is influenced by the severity of the penalty. If the penalty is only a civil fine the rate at which tickets are contested can be relatively small.

6) Allocation of fine revenue

One of the persistent objections to ASE is that it is more about government revenue generation, than safety improvement. Since having public acceptance of ASE is an important part of the project design, deciding how revenue from ASE violations is allocated is a key issue. As an initial matter, in most jurisdictions with ASE, fine revenue first goes to pay for the operation of the program itself. With respect to excess revenue, in some jurisdictions the excess goes to the jurisdiction's general fund as it does with conventional speeding tickets. In other jurisdictions, the excess is allocated to law enforcement units or to special funds dedicated to road safety improvements. Polling of Minnesotans showed that when ASE revenue is used for local road safety programs, net support for ASE increases. (4)

7) Threshold speed that triggers an ASE violation

A common concern with ASE among the public is that tickets will be automatically issued for vehicles travelling only slightly over the posted limit. As a legal matter, ASE equipment can be set to issue a ticket only if the vehicle is travelling some threshold speed over the posted limit, but the legislature should specifically approve this in the ASE authorizing legislation. (4) This has been the practice in other states. (4)

For work and school zones, this raises an important practical question: what is the relevant posted speed limit? In Minnesota, work and school zones are subject to lower speed limits (i.e., lower than the default speed limit for the given roadway type) but only when workers and children are present. (18) If the ASE equipment is only going to enforce the lower work and school zone speed limits, the program must be structured to provide a mechanism for establishing and documenting whether children or workers are present at the time of the violation. As discussed above, options include having the operator of a manned ASE unit confirm the presence of children or workers, or the use of ASE technology that takes can take pictures of the roadway area at the time of the violation to confirm the presence of children or workers.

8) Accuracy of the state's driver and vehicle ownership database

An ASE program is dependent on the state having a database with up-to-date information on vehicle ownership, as well as driver and vehicle owner mailing addresses. To the extent this information is not up-to-date or otherwise contains errors, the correct person may not receive the ASE citation. This can impact not only the effectiveness of the program but also the level of public acceptance.

Errors in the state's database can create two different kinds of problems. First, under an owner-liability system, the wrong person may receive the citation if vehicle-ownership information is not correct due to lags in the state's database reflecting current vehicle ownership. To the extent this is expected to be a problem, it can be mitigated to some degree by having a straightforward procedure in place by which a ticket issued to the wrong person could be contested and corrected relatively quickly.

Second, under either an owner-liability or a driver liability system, the state may have an out-of-date mailing address for the cited driver or owner. Setting aside the responsibility of individuals to inform the state of an address change, such problem can be mitigated in the design of the penalties for nonpayment of ASE fines. (31) For example, nonpayment could have no other consequence than an inability to renew the vehicles registration until the fine is paid.

9) Program Evaluation

The pilot project needs to be designed, including having sufficient duration, so that it can be appropriately evaluated. To do so, criteria need to be established by which the performance of the project will be measured. Guidance on this can be taken from pilot projects in other states on ASE. Importance outcomes to evaluate include: speed reductions, including speed reductions by types of vehicle (e.g., truck v. car); impact on speed variance; extent of the speed reductions beyond the ASE enforcement area (i.e., the halo effect); and acceptance among key stakeholders and the general public. (5, 6, 7, 8)

Chapter 4: Scenario Development: Step Two -- Obstacles Emerge

The second step of the scenario development process involved narrowing the design options identified into a discreet set of preferred scenarios. This step was informed by both the experience seen in other states, as well as engagement with an advisory panel consisting of stakeholders and experts from relevant fields such as law and engineering. The stakeholders included officials from the relevant departments of state government (e.g., MnDOT, DPS), a local school district representative and a legislator. Though there are important stakeholders outside state government (e.g., work zone contractors), they were not included as this study sought first to build consensus around potential project designs within government.

The discussion in this chapter is divided between ASE in work zones and ASE in school zones, though many of the issues overlap.

A) Work Zones

Overall, this step unexpectedly led to little progress in identifying preferred scenarios for a work zone pilot project. There was general consensus among the advisory panel that ASE would likely have a positive impact on work zone safety, and there was agreement on some relatively straightforward technical issues for the pilot's design. (See chapter 5 below) However, beyond that, the process did not result in identifying a set of cohesive pilot designs expected both: (a) to materially improve work zone safety and (b) to have a reasonable chance of approval by policymakers.

This lack of progress appeared attributable to three causes: (i) political headwinds for ASE that became clear during the course of the study; (ii) the lack of a reasonably clear path for approval of ASE by policymakers led to the perception that all design options needed to be kept on the table; and (iii) a gap in data meant an important policy question could not be answered.

1) Political Headwinds for Automated Enforcement Made Clear

During the course of this study, a bi-partisan bill to authorize Minnesota cities to use red-light cameras was introduced at the 2013 session of the Minnesota state legislature. (28, 29) This was an initiative unconnected with this study. Legislative hearings were held and the bill was defeated relatively quickly in committee. The bill's defeat made it apparent that there was still insufficient support among state lawmakers for automated red-light enforcement.

The bill lacked support from legislators because of jurisdictional and privacy concerns, among other things. While these issues could potentially be addressed in a carefully designed ASE work zone pilot project, politically there is a perception that all of the problems associated with authorizing the use of red-light cameras statewide would necessarily be problems for an ASE pilot.

Equally important for this study was that, in the legislative hearings for this bill, portions of the state's law enforcement community came out strongly in opposition to automated red-light enforcement. They had not publicly taken this position before. Legislators heard testimony in opposition from representatives of the Minnesota Police and Peace Officers Association (MPPOA) and the Minneapolis Police Federation, organizations that represent Minnesota's rank and file law enforcement officers. Their testimony listed a range of criticisms of automated red-light enforcement. For example, Dennis Flaherty, Executive Director of the MPPOA, testified that "'Photo-cop' is revenue driven . . . Make no mistake that this is what this bill is all about. That is the incentive behind these efforts. These programs create more ill will towards police than almost any other single effort that we may get involved with." (28) Law enforcement's opposition featured prominently in the media's coverage of the hearings and explanations of why the red-light bill failed.

For moving forward with ASE in Minnesota, this strong and open opposition to automated enforcement from the police community creates a substantial roadblock. The opinion of law enforcement holds significant influence among the public and lawmakers with respect to matters of traffic safety. Opinion polls consistently show that police officers are trusted by the public, far more than politicians. (29) Accordingly, the outcome with the red-light bill meant that, for at least the time being, ASE may have lost any political momentum it may have had, particularly any momentum it had gained from the polling showing public support for ASE.

2) No Clear Path Forward for ASE Means All Design Options Need to be on the Table

The manner in which the red-light camera bill was defeated proved influential for this study. Members of the advisory panel largely agreed that ASE could be a valuable tool to add to the traffic safety toolbox for work zones. Yet, the strong opposition from law enforcement groups and an apparent lack of enthusiasm among lawmakers for automated enforcement meant there was not a relatively clear path ahead for approval of an ASE pilot project. Moreover, the hearings on the red-light bill did not add clarity to the question of what design elements for automated enforcement would make lawmakers more or less likely to approve an ASE pilot project.

For the study, this meant the political context did not provide direction for making selections about which design elements were preferable. Rather the opposite occurred. It created a view that, in the current policy climate for ASE, it was best to leave the door open on most of the design questions. This was because answering these questions involved political and policy trade-offs for which there was insufficient clarity in the Minnesota context at this time to find consensus on design choices. Accordingly, the following types of central issues were left unresolved:

- Driver versus owner liability.
- Civil versus criminal penalties.
- The extent automated warnings are to be used.
- The penalties for non-payment of ASE fines.
- Type of ASE unit to be employed
- The vendor's role in the ticketing process.
- How evidence for ASE is authenticated in court hearings.
- Law enforcement's role in operating and managing the ASE program.
- The threshold speed over the posted limit that triggers an ASE violation.
- Addressing concerns about the accuracy of the state vehicle ownership database.
- The duration of a pilot approach.
- The goals of a pilot, and the means of evaluating whether the goals are met.
- Allocation of fine revenue.

Progress was made on certain technical and non-controversial project design matters, such as identifying interstates as the best work zone pilot locations. (See chapter 5 below) But with respect to most of the design questions, the result was a menu of options rather than a set of preferred scenarios.

3) Data Deficiencies

Part of the larger policy backdrop to the automated enforcement debates in Minnesota is that the state's crash rates, including the rate of fatal crashes, have fallen substantially in the last decade. Hence, part of the case against work zone ASE in Minnesota is that the existing traffic safety tools and resources are working to such a degree that the additional marginal reductions in the crash rate that may come from work zone ASE are either (i) outweighed by the operational and political costs involved in implementing ASE, or (ii) could be achieved more simply by expanding the existing set of traffic safety tools.

In part, responding to this argument calls for evidence showing that the current set of traffic safety tools are not making work zones safer to the same degree they are make all roads safer. As outlined above, the existing data cannot show the relative safety of work zones as compared to non-work zones. To make such an assessment, data on the number of work zone miles travelled per year, or the development of some suitable proxy, is needed. With this data, a crash rate per work zone mile travelled could be developed to assess the relative safety of work zones. Without such information, however, the straightforward quantitative safety justification for work zone ASE is notably weakened. As a result, the other reasons to have work zone ASE become more important. These reasons include that work zones should be made safer than roads generally to protect vulnerable construction workers and law enforcement personnel providing conventional speed enforcement.

B) School Zones

The identification of preferred scenarios for an ASE pilot in school zones suffered from many of the same obstacles discussed above with respect to work zones (e.g., political headwinds, no clear path to policy approval, and data deficiencies). Scenario development for school zones also suffered from two distinct additional challenges not faced with work zones. First, deployment of ASE in school zones would require the support and operational involvement of local government. Hence, a school zone pilot requires navigating jurisdictional challenges not necessarily present with a work zones pilot (a work zone pilot could take place in a state-operated work zone, thus avoiding local jurisdictional issues). Second, the crash data analysis did not identify a statewide speed-related crash problem in school zones. Thus, the case for a school zone pilot is likely one that will need to be driven by local needs to increase safety at particular sites. The data needed to identify such sites was not available for this study.

For these reasons, as with work zones, relatively little progress was made in identifying preferred scenarios for school zone pilot projects, other than with respect to some technical issues discussed further below in chapter 5.

Chapter 5. Elements of an ASE Pilot Project

This chapter catalogues certain key design elements of an ASE pilot program in work and school zones. The catalogue includes options with respect those elements, considerations involved in making choices with respect to these elements, and finally the extent to which preferred options were identified in this study.

The program elements identified in this chapter are not intended to be exhaustive. Rather, they are those elements that appear to involve the most operationally prominent questions or involve the most difficult policy issues. Moreover, the considerations identified for each element are likewise not intended to be exhaustive, but rather capture some of the main issues involved with making decisions about each element.

Among other things, the discussion of program design elements in this chapter illustrates that many of these elements are interdependent and involve difficult trade-offs, generally along three dimensions: (i) politics or public acceptance; (ii) operational challenges/cost issues; and (iii) effectives in terms of reducing speeds. It also illustrates that with respect to this third dimension -- effectiveness in terms of reducing speeds -- there is often insufficient existing information to know what impact certain program design choices will have on ASE's effectiveness. This suggests that, for some of these elements, the pilot project may benefit from experimenting with different design options (e.g., the use of automated warnings along with ASE citations that carry penalties) to the extent feasible.

This chapter is organized into two sections. Section A contains three tables that list project design elements, options and considerations involved with respect to each element and the extent to which this study identified a preferred option. Table 6 contains those program design elements that apply to both work and school zones. Table 7 provides those that apply to just work zones. Table 9 provides those that apply to school zones.

Section B then provides a summary of the choices three states with work zone ASE have made with respect to some of the program design elements discussed in section A. This section illustrates that while putting together an ASE program involves some difficult design decisions, those choices -- and the related trade-offs -- do not create insurmountable obstacles.

A) ASE Program Elements

Table 6. Project elements that apply to an ASE pilot project in both work and school zones.

	Program Element	Options & Considerations	Preferred Option
1.	Who is responsible for the ASE speeding violation?	Options: (i) *the vehicle driver* or (ii) *the vehicle owner*. Considerations: - *Cost*: an owner-liability system may be less costly to administer per ticket because there is less back office work in identifying the driver. - *Citation rate*: owner-liability may result in a higher ratio of detected violations resulting in issued citations, relative to driver-liability. - *Nature of the Penalty*: with owner-liability, penalties generally must be civil in nature; with driver-liability, the penalty may be either civil or criminal. - *Privacy*: privacy concerns are generally higher with driver-liability because it involves the ASE equipment capturing an image of the driver; however, polling does show increased support for ASE when the driver is identified with facial recognition technology. (4) - *Penalty for non-payment*: penalties for non-payment can be greater under a driver-liability system than under an owner-liability system because of the due process considerations. - *Consistency with traditional enforcement*: holding the driver liable is more consistent with traditional speeding enforcement methods.	• Not determined in this study.
2.	What is the legal nature of the penalty for an ASE violation?	Options: (i) *civil penalty*, akin to a parking violation; or (ii) *criminal penalty*, same as for conventional speeding violation (a petty misdemeanor in Minnesota). Considerations:	• Not determined in this study

		- *Responsible party*: with owner-liability, penalty must be civil in nature. - *Effectiveness/deterrence*: it is not known whether having civil or criminal penalties impacts ASE's effectiveness. - *Challenge rate*: experience in other states suggests that more ASE citations are challenged in court if they involve the higher penalties of a criminal sanction. - *Consistency with traditional enforcement*: having a criminal sanction is more consistent with traditional speeding enforcement methods. - *Impact on traditional enforcement*: it is not known what impact a lesser penalty for ASE violations, compared to traditional speeding tickets, has on the effectiveness as well as the public's opinion of traditional speed enforcement. - *Accuracy of state database:* the greater the concern about the accuracy of the state driver and vehicle ownership databases, the more concern there is about imposing the higher penalties of criminal sanctions for ASE violations.	
3.	What is the sanction for non-payment of the ASE penalty, or not contesting the citation?	<u>Options</u>: options vary and include: charging late fees; sending the unpaid amounts to collections; preventing registration renewal of the vehicle and/or the driver's license; or suspending the registration of the vehicle. <u>Considerations</u>: - *Responsible Party*: under an owner-liability system, the penalties for non-payment cannot be such that they amount to creating the equivalent of a criminal penalty; whereas under a driver-liability system, the penalties for non-payment could be the same as they are for the non-payment of a traditional speeding ticket. - *Accuracy of state database*: the greater the concern about the accuracy of the state driver and vehicle ownership databases, the more concern there is about imposing greater penalties for non-payment of ASE fines. - *Effectiveness/deterrence*: it is unknown to what degree the penalty for	• Not determined in this study

		non-payment impacts the effectiveness of ASE.	
4.	Will the efficacy of automated warnings be tested beyond the initial deployment period?	Options: test the relative effectiveness of ASE warnings, as compared to ASE fines. Considerations: - *Cost:* since ASE programs are typically dependent on fine revenue for their funding, the replacement of fines with warnings can impact how an ASE program is financed; on the other hand, warnings may reduce some administration costs, such as costs to the judiciary. - *Confusion among the public:* if the program issues warnings for some locations but not in others, this may create confusion among the public about the program. - *Effectiveness/deterrence*: it is unknown to what degree the severity of the penalty impacts the effectiveness of ASE. - *ASE penalty:* the use of warnings can resolve the trade-offs between the use of civil and criminal penalties for ASE violations. - *Impact on conventional speed enforcement*: it is not known what impact issuing a warning for ASE violations would have on the effectiveness as well as the public's opinion of conventional speed enforcement.	• The effectiveness of ASE warnings should be tested in an ASE pilot project.
5.	What is the scope and nature of the involvement of a private vendor in the program?	Options: the key variables with vendor involvement include whether: (i) the vendor's compensation is a flat fee or varies based on the number of tickets issued; (ii) the vendor has input on the location of ASE units; and (iii) the involvement of vendor employees in the operations of the ASE program. Considerations: - *Public Acceptance*: the fewer actual or perceived incentives vendors have to issue tickets, the fewer the potential grounds for the public to object to a private company being involved in speed enforcement.	• Vendor compensation should not be dependent on the number of tickets issued. • ASE authorizing legislation should prescribe that any data generated by

		- *Data Privacy*: the legislation authorizing any ASE program may need to address vendors' obligations with respect to the handling and use of any personally identifiable data produced as a result of the ASE program. - *Staffing Costs*: it may be less costly to have vendor employees staff any manned-ASE units and be involved in authenticating ASE evidence in court, as opposed to having law enforcement staff have these responsibilities.	ASE equipment may not be used by the vendor for any purposes other than in connection with the execution of its responsibility with respect to the ASE program.
6.	How evidence of an ASE violation is authenticated for admission in a court proceeding adjudicating the violation?	Options: options include: (i) authentication by a vendor employee; (ii) authentication by a law enforcement officer; or (iii) self-authentication. Considerations: - *Nature of the Penalty*: if the penalty is civil in nature, the more legal flexibility there is to have the evidence self-authenticated; moreover, criminal penalties may increase the rate at which ASE citations are contested in court. - *Cost*: self-authentication would involve less staff costs for court appearances.	• Not determined in this study.
7.	How is revenue from fines allocated?	Options: other jurisdictions typically use ASE fine revenue to first pay for the cost of the ASE program; with respect to excess revenue, practices in other jurisdictions can differ; some allocate the excess to the general fund, generally in the same manner they allocate revenue from conventional speeding tickets; other jurisdiction allocate the excess to law enforcement or traffic safety programs. Considerations: - *Self-financing of ASE*: one of the advantages of ASE for policymakers is that the program can pay for itself through fine revenue.	• Not determined in this study.

		- *Public Acceptance*: public opinion polling of Minnesotans shows that support for ASE increases if the revenue from the program is used for local safety improvements. (4)	
8.	At what speed, if any, over the posted limit is an ASE violation triggered?	Options: if the legislature chooses to do so, it can identify a speed over the posted speed limit for which an ASE will be issued. Considerations: - *Public acceptance*: polling of Minnesota residents showing increased support for ASE if citations are only issued for extreme speeders. (4) - *Legislature can address*: in any authorizing legislation, lawmakers can address this issue of the threshold speed to avoid public confusion on the subject and provide more legal certain for the program. - *Nature of penalty:* if the penalty for an ASE violation is equivalent to that of a conventional ticket (i.e., criminal, petty misdemeanor), this could suggest making the ASE speed limit the same as the posted speed limit as has been done in some other jurisdiction, such as Illinois with respect to work zones.	• In any authorizing legislation, lawmakers should address this issue of the threshold speed to avoid public confusion on the subject and provide more legal certain for the program. • A specific threshold speed was not determined in this study.
9.	How should the impact of out-of-date mailing addresses in the state's driver licensing database be mitigated?	Options: to the extent there is a concern about driver's not receiving citations under a driver-liability system because the mailing address on their driver's licensing is out-of-date, this can be mitigated by reducing the penalties for the non-payment of ASE violations; for example, the penalty could be limited to preventing the renewal of the driver's license or the renewal of the driver's vehicle until the fine is paid. Considerations: - *Who is responsible*: this issue only arises with a driver-liability system. - *Driver's existing legal obligations*: under existing law, drivers are required to apply for a new license within 30-days of changing their	• Not determined in this study.

		address. (31) - *Effectiveness/deterrence*: it is unknown to what degree the penalty for non-payment impacts the effectiveness of ASE.	
10.	How should the impact of errors in the state's vehicle ownership database be mitigated?	Options: To the extent there is a concern about the former owner of a vehicle receiving a citation under an owner-liability system because the state's vehicle-ownership database does not reflect current ownership of the vehicle at the time of the violation, this can be mitigated by creating a straight-forward procedure for the former vehicle owner to raise their non-ownership of the vehicle as a defense; an additional option could include having the former owner have an obligation to identify the party to whom the vehicle was sold as part of raising this defense. Considerations: - *Who is responsible:* this issue only arises with an owner-liability system. - *Former owner's existing obligation*: under Minnesota's current vehicle ownership system, if an individual sells their vehicle to another individual, they are obligated to report that sale to the Department of Public Safety, thereby alerting the state of the transfer. - *Technology upgrades*: the Department of Public Safety is making improvements to their database system to shorten the time between their receipt of documentation of a title change, and when that change is reflected in their database.	• Not determined in this study.
11.	In what manner should the public be informed about the ASE program?	Options: options for giving the public notice of the program include: a public information and outreach campaign; once ASE units are deployed at a site, a warning period before the issuance of citations that carry penalties; the general location of ASE units can be disclosed online to inform drivers; deployment locations can have signage informing travelers of the use of ASE; "your speed"	• Education is an important of a successful ASE program. The specific form of

		signs can assist drivers in compliance in areas monitored by ASE units. Considerations: - *Public acceptance*: the greater the extent the public is informed about the program, the lower the risk that the public perceives the program as being operated unfairly.	this education was not determined in this study.
12.	What special defenses can someone that receives an ASE ticket raise?	Options: permissible defenses may include: (i) in the case of owner-liability, that the license plates or the vehicle itself had been stolen at the time of the violation, that the vehicle was leased (e.g., a rental car), or that the owner was not the driver at the time of the violation; and (ii) the ASE violator received a conventional speeding ticket for the same speeding violation. Considerations: - *Who is responsible:* whether the ASE program is an owner or driver-liability system will shape what special defenses are relevant. - *Legislature should address*: in any authorizing legislation, lawmakers should address what, if any, special defenses alleged violators may raise; further, the legislature should establish procedures by which common defenses can be raised; for example, under an owner-liability system, procedures by which rental car companies can transfer liability to the vehicle renter.	• Not determined in this study.
13.	Should the presence of ASE units be hidden from driver's view or should ASE be conspicuous?	Options: ASE units can either be conspicuous to drivers or hidden. Considerations: - *Public acceptance:* public acceptance of ASE will likely be greater if ASE units are conspicuous, as that lends to the perception that the program's purpose is to reduce speeding and not to issue tickets, and that the program is operated in a fair manner.	• ASE units should be conspicuous.

		- *Effectiveness*: it is not known whether the effectiveness of ASE in reducing speeds is influenced by whether the units are conspicuous to drivers or hidden. - *Safety*: well-marked and signed ASE areas may increase the safety of enforcement areas by reducing sudden changes in vehicle speeds as a result of drivers reacting to the sudden visibility of an ASE unit.	
14.	How is data collected by ASE protected?	Options: data privacy concerns can either be addressed in the legislation authorizing the use of ASE or via a more general data privacy statute. Considerations: - *Public acceptance*: greater data privacy protections will likely improve the public's acceptance of ASE. - *Access by law enforcement:* to what extent will law enforcement be able to access ASE data for reasons other than the prosecution of the underlying offense, and how long the ASE data is retained beyond the resolution of the speeding offense. - *Who is responsible*: a driver-liability system generally creates more data privacy concerns than an owner-liability system because it produces data that identifies where a particularly person was at a certain point in time.	• Data privacy concerns should be addressed directly in the ASE authorizing legislation, to the extent it has not been adequately dealt with by a more general data privacy statute.
15.	What type of ASE technology should be employed?	Options: there are a number of types of ASE technologies available, from a number of different vendors, including radar and LIDAR based devises. Considerations: - *Maintaining flexibility*: given the rate at which new technologies are being developed by ASE vendors, the agency operating the ASE program should have flexibility to identify and select the most appropriate technology to fit the deployment circumstances. - *Standards available:* the Enforcement Technology Advisory Technical	• ASE authorizing legislation should not require the use of any particular ASE technology.

		Subcommittee of the International Association of Chiefs of Police has developed standards against which to measure the performance of ASE equipment.	

Table 7. Project elements that apply to an ASE pilot project in work zones.

	Program Element	Options & Considerations	Preferred Option
1.	What type of ASE unit will be used?	Options: (i) fixed, infrastructure based units; (ii) unmanned mobile units; (iii) manned, mobile in-vehicle units. Considerations: - *Construction zones are impermanent*: fixed, infrastructure units are likely not appropriate for construction zones given the impermanence of work areas. - *Need to confirm presence of workers*: under Minnesota law, the lower work zone speed limits are only in effect when workers are present; a manned in-vehicle unit has the advantage of allowing the operator to confirm the presence of workers at the time of the violation; an alternative is to have the ASE equipment take a wide angle photo of the work zone to provide visual evidence of the presence of workers at the time of the violation.	In light of the experience in other states, manned in-vehicle units are likely the best choice for work zone ASE at this time.
2.	Where should an ASE work zone pilot project be located?	Options: a pilot ASE work zone project could be located in a variety of work zone location. Considerations: - *Duration of work zones*: work zones that are longer in duration are likely to be more suitable; among other things, the longer duration will allow for larger before-and-after samples for evaluation purposes.	• Interstate work sites, involving lane closures, are likely the most appropriate sites.

		- *Length of work zones*: zones that are longer in length are likely to be more suitable (e.g., 4-5 miles, or longer); this will allow more data collection points, including (i) upstream from the ASE unit; (ii) at the ASE unit; (iii) downstream; and (iv) far downstream. - *Jurisdictional issues*: the fewer governmental jurisdictions involved in the project, the less complicated the interagency coordination part of the project will be; therefore roadways, such as interstates, that are managed by MnDOT may be the most suitable from an administrative perspective. - *Identified speeding and crash problem*: the analysis of the crash data in chapter 3 of this report points to interstate projects involving lane closures as being an appropriated target location given the predominance of speed related crashes there, with the speed reduction efforts focused within the work activity areas.	
3.	How should a work zone pilot be evaluated?	Options: four general categories of relevant outcomes can be evaluated: (i) impact of ASE on vehicle speeds in the enforcement area in the work zone; (ii) impact of ASE on vehicle speeds outside the enforcement area in the work zone (i.e., halo effect); (iii) public and key stakeholder opinion of ASE; and (iv) the administrative and financial impact on administering agencies. Considerations: - *Planning for data collection*: data collection should permit evaluations of: vehicle types and road lanes; average and variance in speeds; and work zone conditions (e.g., type of work being done, etc.) - *Impact evaluation types:* generally, two types of impact evaluations could be used: (i) controlled before and after studies, which would require identifying appropriate comparison work zone sites; (ii) interrupted time series studies, which would require the work zone selected for deployment to be of sufficient duration.	Evaluation approach should cover all four identified categories of relevant outcomes.

4.	How will the presence of workers be confirmed to enforce the work zone speed limits	Options: possible options include: (i) the presence of workers is visually confirmed by the ASE unit operator; (ii) units are only deployed during know hours when workers are on site, as confirmed by contractor logs; and (iii) ASE units take pictures of the construction site at the time of the violation to document the presence of workers. Considerations: - *Experience in other states*: generally, other states with work zone ASE use manned in-vehicle units, which permit visual confirmation of the presence of workers. - *Limited experience with technological solution*. there appears to be limited experience with using ASE units themselves to confirm the presence of workers in the work site. - *Legislative changes:* changing state law to have work zone speed limits in effect in the absence of workers, only to facilitate an ASE pilot project of limited duration, is likely not politically feasible.	Not determined in this study.
5.	How will relevant public agencies coordinate their efforts and which agency will lead the program?	Options: possible options include the creation of an interagency task force to coordinate inter-government cooperation. Considerations: - *Cooperation critical:* experience in other states has shown that intra-government cooperation is critical to the success of ASE programs. - *Lead agency:* MnDOT is a likely candidate to lead an ASE pilot project; in other states, the state's transportation department has led ASE projects but in close partnership with the state's law enforcement department.	Not determined in this study.

Table 8. Project elements that apply to an ASE pilot project in school zones

1	What type of ASE unit will be used?	Options: (i) fixed, infrastructure based units; (ii) unmanned mobile units; (iii) manned, mobile in-vehicle units. Considerations: - *Need to confirm presence of students*: under Minnesota law, the lower school zone speed limits are only in effect when students are present; a manned in-vehicle unit has the advantage of allowing the operator to confirm the presence of students at the time of the violation; an alternative is to have the ASE equipment take a wide angle photo of the school zone to provide visual evidence of the presence of students at the time of the violation, though this may raise additional privacy concerns. - *School zones have limited hours of reduced speed limits*: given that there are limited hours in which school speed zones are in effect, investment in fixed, infrastructure units many not be appropriate. -	Not determined in this study.
2	Where should an ASE school zone pilot project be located?	Options: school zones with speeding problems need to be identified to determine appropriate candidates for an ASE pilot project. Considerations: - *Jurisdictional issues*: ASE in school zones will necessarily require partnering with local government, including local law enforcement and school districts. - *Lack of data*: there is a lack of statewide data regarding what particular school zones may have a speeding problem; site identification will need to come from local partners working with state agencies. - *Level of community endorsement*: the level of community support of the project should factor into the site selection process.	Not determined in this study.

3	How should a school zone pilot be evaluated?	Options: four general categories of relevant outcomes can be evaluated: (i) impact of ASE on vehicle speeds in the enforcement area in the school zone; (ii) impact of ASE on vehicle speeds outside the enforcement area (i.e., halo effect); (iii) public and key stakeholder opinion of ASE; and (iv) administrative and financial impact on administering agencies. Considerations: - *Planning for data collection*: data collection should permit evaluations of: vehicle types and lanes; and average and variance in speeds. - *Impact evaluation types: g*enerally, two types of impact evaluations could be used: (i) controlled before and after studies, which would require identifying appropriate comparison sites for school zones selected for ASE deployment; (ii) interrupted time series studies, which would require the study to be of sufficient duration to allow for a large enough study time period.	Not determined in this study.
4	How will the presence of schools be confirmed to enforce the work zone speed limits	Options: possible options include: (i) the presence of students is visually confirmed by the operator of the ASE unit; (ii) units are only deployed during hours when students are known to be coming to and from school; and (iii) ASE units take wide angle pictures of the school zone site at the time of the violation to confirm presence of students. Considerations: - *Limited experience with technological solution:* there appears to be limited experience with using ASE units themselves to take photographs to confirm the presence of students in school zones at the time of the violation. - *Privacy consideration*: using ASE technology to confirm the presence of students at the time of the violation will likely raise additional privacy concerns since the camera would be capturing images of	Not determined in this study.

		minors. - *Legislative changes:* changing the law to have school zone speed limits in effect in the absence of students, only to facilitate an ASE pilot project of limited duration, is likely not politically feasible.	

B) Experience in Other States

Illinois, Maryland and Washington are three states with ASE programs specifically set-up for work zones. (6, 7, 8, 23) Each state has confronted many of the program design choices outlines in Section 1 above. Table 9 below summarizes the choices that each of these states has made with respect to some of these design choices.

Of the three, Maryland and Washington are the two most recently developed programs and this, in part, explains why their program designs are more similar to each other, relative to Illinois. Notwithstanding the different program design configurations, each state has found that ASE reduces speeds in work zones. (6, 7, 8, 23)

Table 9. Work Zone ASE Program Designs in Other States

	Illinois	**Maryland**	**Washington**
Type of ASE Units	Manned, In-Vehicle	Manned, In-Vehicle	Manned, In-Vehicle
Who Staff's the Unit	State Patrol	Vendor	Vendor
Liability System	Driver	Owner	Owner
Speed Threshold	Same as posted	12 mph over	11 mph over
Fine Amount	\$375 (1st offense)	\$40	\$137
Impact on Driving Record	Same as conventional ticket	No points on record	Not on record
Excess Revenue	Same as conventional ticket	To state patrol	To state patrol
Failure to pay fine	Same as conventional ticket	\$ penalties and vehicle registration suspended	Treated same as parking ticket

Chapter 6. Lessons Learned and Next Steps

The intent of this study was to develop a set of discreet preferred scenarios for an ASE pilot project in Minnesota work and school zones. The study's departure point was public opinion polling in Minnesota showing overwhelming support for ASE in work and school zones, along with the evidence from other states showing ASE reduces speeding in work and school zones. However, during the course of this study, obstacles emerged to identifying a set of preferred project designs. The reasons for these obstacles appeared threefold: (a) the political headwinds for ASE made clear by the defeat of a 2013 red-light camera bill at the legislature and the open opposition to automated red-light enforcement from law enforcement organizations; (b) the lack of a reasonably clear path for approval of ASE by policymakers led to the view that all design options need to be kept on the table; and (c) a lack of data on the existing speeding problem weakened the straight-forward quantitative justification for ASE in work and school zones.

Generally, public opposition is the foremost reason cited for the limited use of ASE in the U.S. This study points to three additional factors that may be equally important, but not as well appreciated. *First*, public opposition to automated enforcement from the law enforcement community can be influential for the political prospects of ASE. As has been the experience in some other states, the likelihood of ASE moving forward increases when law enforcement joins as a full partner in ASE programs from the initial stages.

Second, given the operational and political challenges, the quantitative justification for ASE needs to be strong. The data showing that ASE can reduce speeding in certain settings is relatively well established. However, data showing that ASE can address a safety problem not currently being met by existing traffic safety tools and resources often may not be available. Efforts to move forward with ASE will benefit from planning for such data needs in advance.

Third, implementing an ASE program in work or school zones requires the involvement and cooperation of a number of different governmental actors, including law enforcement, transportation agencies, the judiciary, school administrators and the agency that maintains driver and vehicle information. Among these actors there can be differing institutional perspectives regarding ASE, both on whether ASE generally is a worthwhile policy endeavor and how any ASE program should be designed with respect to many of the elements identified in this report. Reconciling these differing perspectives will require, among other things, policymakers who believe in ASE as a valuable safety tool championing it in order to generate the needed political and policy momentum needed to work through these differences.

The identification of these three additional factors opens up several new channels of research to better understand what is preventing the greater use of ASE, both in Minnesota as well as across the U.S. These additional channels include investigating the drivers behind the varying institutional perspectives within government on ASE, including law enforcement.

References

1. Wilson, C., et al., "Speed cameras for the prevention of road traffic injuries and deaths," *Cochrane Database of Systematic Reviews* (2010), Issue 10.
2. Eccles, Kimberly A., et. al., "Automated Enforcement for Speeding and Red Light Running," TRB National Cooperative Highway Research Program Report 729, Washington D.C. (2012).
3. Governors Highway Safety Association (GHSA), *Speeding and Aggressive Driving: Survey of the States*, GHSA: Washington D.C. (2012), available at http://www.ghsa.org/html/publications/survey/speed2012.html (last accessed July 30, 2013).
4. Douma, F. et al., "Identifying Issues Related to Deployment of Automated Speed Enforcement," University of Minnesota Center for Transportation Studies, Report no. CTS 12-23 (2012).
5. Benekohal, R.F., M.V. Chitturi, A. Hajbabaie, M. H. Wang, and J. C. Medina, "Automated Speed Photo Enforcement Effects on Speeds in Work Zones," in Transportation Research Record: Journal of the Transportation Research Board, No. 2055, Transportation Research Board of the National Academies, Washington, D.C. (2008), pp.11–20.
6. Tobias, P. "Research Pays Off: Automated Speed Enforcement Slows Down Drivers in Work Zones." TR News, No. 277 (2011, pp. 29-31.
7. Maryland Safetyzones, *Automated Speed Enforcement in Work Zones* (2013), available at http://www.safezones.maryland.gov/index.html (last accessed July 30, 2013).
8. Washington Traffic Safety Commission, *Automated Speed Enforcement Pilot Project Evaluation* (2011), available at http://www.wtsc.wa.gov/statistics-reports/research-studies/ (last accessed July 30, 2013).
9. Freedman, M., De Leonardis, D., Raisman, G., InyoSwan, D., Davis, A., *Demonstration of Automated Speed Enforcement in School Zones in Portland, Oregon*, Report No. DOT HS 810 764, Washington, DC: National Highway Traffic Safety Administration (2006.
10. Goodwin, A., Kirley, B., Sandt, L., Hall, W., Thomas, L., O'Brien, N., & Summerlin, D.. *Countermeasures that work: A highway safety countermeasures guide for State Highway Safety Offices*. 7th edition. (Report No. DOT HS 811 727). Washington, DC: National Highway Traffic Safety Administration (2013, April).
11. Adams J. and VanDrasek, B, *Automated Enforcement of Red-Light Running & Speeding Laws in Minnesota: Bridging Technology and Public Policy*, University of Minnesota Center for Transportation Studies, CTS 09-26 (2009), available at http://www.cts.umn.edu/Publications/ResearchReports/reportdetail.html?id=1832 (last accessed May 17, 2012).
12. *State v. Kuhlman*, 729 N.W.2d 577 (Minnesota 2007).
13. Munnich, Jr., Lee, and Joseph D. Loveland, "Do Americans Oppose Controversial Evidence-Based Road Safety Policies?" *Transportation Research Record: Journal of the Transportation Research Board*, No. 2213, Transportation Research Board of the National Academies, Washington, D.C. (2011), pp. 9-12.
14. Shaheen, S. A., C. J. Rodier, and E. Cavanagh, *Automated Speed Enforcement in the U.S.: A Review of the Literature on Benefits and Barriers to Implementation*, Institute of

Transportation Studies, University of California, Davis, Research Report UCD-ITS-RR-07-17 (2007).
15. Data Source: Minnesota Department of Transportation, Crash Data 2003-2013, provided by Nathan Drews.
16. Minnesota Department of Public Safety Office of Traffic Safety, "Minnesota Motor Vehicle Crash Facts - 2012" (2013).
17. NHTSA, NCSA Data Resource Website, Fatality Analysis Reporting System Encyclopedia (2013), available at http://www-fars.nhtsa.dot.gov/Trends/TrendsGeneral.aspx (last accessed July 30, 2013).
18. Minn. Stat. 169.14 (2013).
19. Schroeder, Glenn, "Zero tolerance for work zone speeders," (2011) available at http://www.krmg.com/news/news/local/zero-tolerance-work-zone-speeders/nCF2x/ (last accessed September 22, 2013); Missouri Department of Public Safety, "Operation P.R.O.T.E.C.T. to be held in St. Louis County," (2011) available at http://notes.mshp.dps.mo.gov/si01/si01p001.nsf/0/2281448ad4311f0f862578e0006d9050?OpenDocument (last accessed September 22, 2013); The Herald-Independent, "Sheriff's traffic team warns motorists of zero tolerance for speeders in construction zone," (2011) available at http://www.hngnews.com/monona_cottage_grove/news/article_31406086-961d-5198-b7ea-540562a20dfd.html (last accessed September 22, 2013).
20. Data Source: Minnesota Department of Transportation, Crash Data 2002-2011, provided by Nathan Drews.
21. GHSA, Speed and Red Light Camera Laws, GHSA: Washington D.C. (2014), available at http://www.ghsa.org/html/stateinfo/laws/auto_enforce.html (last accessed January 3, 2014).
22. *State v. Dahl*, 336 Ore. 481 (Or. 2004); *Shavitz v. City of High Point*, 270 F.Supp 2d 702 (M.D.N.C. 2003), *vacated on other grounds, Shavitz v. Guilford County Board of Education,* 100 Fed. Appx 146 (4th Cir. 2004) (with respect to red-light cameras); *Idris v. City of Chicago*, 552 F.3d 564 (7th Cir. 2009) (with respect to red-light cameras).
23. Washington Department of Transportation, "Automated Speed Enforcement Cameras" (2013), available at http://www.wsdot.wa.gov/safety/atsc.htm (last accessed July 30, 2013).
24. Preusser, D. F., A. F. Williams, J. L. Nichols, J. Tison, and N. K. Chaudhary, *Effectiveness of Behavioral Highway Safety Countermeasures*, National Cooperative Highway Research Program Report 622. Transportation Research Board, Washington, D.C. (2008).
25. Minn. R. Evid. 901 & 902.
26. See e.g., *State v. Willis*, 332 N.W.2d 180, 184 (Minn. 1983).
27. Minnesota Senate File 377 (2013); Minnesota House File 487 (2013).
28. Testimony of Dennis Flaherty, Minnesota Police and Peace Officers Association, at the Minnesota House Transportation Policy Committee, February 21, 2013, hearing on Minnesota House File 487 (2013), quoted in Tom Scheck, "Traffic camera bill hits a red light at Minnesota House," Minnesota Public Radio, February 21, 2013, available at http://minnesota.publicradio.org/display/web/2013/02/20/politics/traffic-camera-bill (last accessed July 30, 2013).

29. Gallup, Inc., "Honesty/Ethics in Professions, Nov. 26-29 (2012), available at http://www.gallup.com/poll/1654/Honesty-Ethics-Professions.aspx (last access July 30, 2013).
30. Data Source: Minnesota Department of Transportation, Crash Data 2003-2013, provided by Craig Mittelstadt.
31. Minn. Stat. 171.11 (2013).