

Appendix B

SB 743 Safety Technical Advisory

Analyzing Safety Impacts Related to Transportation

Public Resources Code section 21099 suggests that while automobile delay is not an environmental impact, lead agencies may still evaluate project impacts related to safety. The CEQA Guidelines currently suggest that lead agencies examine projects' potential to “[s]ubstantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment).”

As with any other potential impact, CEQA requires lead agencies to make a judgment call “based to the extent possible on scientific and factual data” (State CEQA Guidelines § 15064(b)). Also like any other potential impact, “the significance of an activity may vary with the setting” (Ibid). Lead agencies must base their evaluations of safety on objective facts, and not personal or subjective fears. The purpose of this section is to review some relevant considerations in evaluating potential transportation-related safety impacts.

Transportation by its nature involves some degree of collision risk. Every project will affect transportation patterns, and as a result may involve some redistribution of that risk.

Lead agencies may consider whether a project may cause substantially unsafe conditions for various roadway users. This section is not intended to provide a comprehensive list of potential transportation safety risks, but rather guidance on how to approach safety analysis given numerous potential risks.

Generally:

- Safety analysis in CEQA should focus on risk of fatality or injury, rather than property damage.
- Lead agencies should focus on concerns that affect many people, not just an individual.
- The potential safety concern must relate to actual project conditions, and not stem solely from subjective fears of an individual.
- Safety analysis in CEQA should focus on undue risks that can be reduced without adding other risks, particularly without increasing risk to vulnerable road users (State CEQA Guidelines § 15126.2(a)(1)(D)). Safety analysis and mitigation under CEQA should not undermine overall public health, e.g. by reducing the physical activity benefits of active transportation.
- In analyzing safety, lead agencies should note that automobile delay is not an indication of environmental impact (Pub. Resources Code § 21099(b)(2)).

In the past, transportation safety has focused on streamlining automobile flow and accommodating driver error, sometimes confounding motor vehicle mobility and speed with transportation system safety. An updated and more holistic approach has developed over the past decade, however. This updated approach focuses on three overlapping strategies:

- Reduce speed and increase driver attention
- Protect vulnerable road users
- Reduce overall VMT and sprawl (see Ewing et al. (2003) below for definition of “sprawl”)

Newer design guidance builds on more recent research on transportation safety and articulates this updated approach. For example, the NACTO guidelines (which have been endorsed by Caltrans, as well as the cities of Davis, Oakland, San Francisco, San Diego, and San Mateo) state:

“Conventional street design is founded in highway design principles that favor wide, straight, flat and open roads with clear zones that forgive and account for inevitable driver error. This is defined as “passive” design. In recent years a new paradigm has emerged for urban streets called proactive design. A proactive approach uses design elements to affect behavior and to lower speeds. Embracing proactive design may be the single most consequential intervention in reducing pedestrian injury and fatality. Since human error is inevitable, reducing the consequences of any given error or lapse of attention is critical. Cities around the country that have implemented measures to reduce and stabilize speed have shown a reduction in serious injuries and deaths for everyone on the road, from drivers to passengers to pedestrians.”

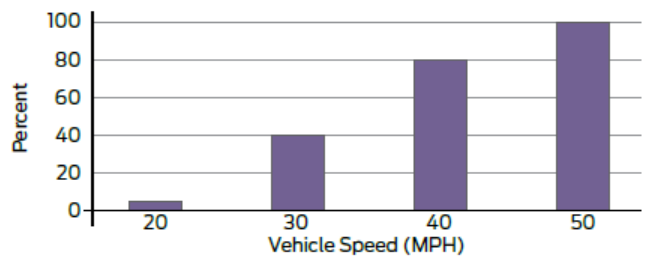
Reducing Speed and Increasing Driver Attention

Vehicle speed plays a fundamental role in transportation safety. The NACTO Urban Street Design Guide, reports: “Vehicle speed plays a critical role in the cause and severity of crashes.” Two charts from those guidelines below show risk associated with motor vehicle speeds.

Higher speeds increase both the likelihood and severity of collisions (Elvik (2005)). According to Elvik:

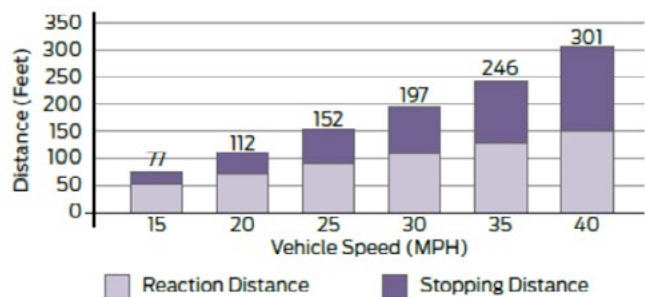
- “Speed is likely to be the single most important determinant of the number of traffic fatalities.”
- “. . . [S] peed has a major impact on the number of accidents and the severity of injuries and that the relationship between speed and road safety is causal, not just statistical.”
- “Changes in speed are found to have a strong relationship to changes in the number of accidents or the severity of injuries.”

Risk of Pedestrian Fatality



Source: NACTO Urban Street Design Guide Overview

Reaction & Stopping Distance vs. Speed



Source: NACTO Urban Street Design Guide Overview

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- “The relationship between speed and road safety is robust and satisfies all criteria of causality commonly applied in evaluation research.”

Regardless of posted speed limits, designing roads to accommodate higher speeds safely actually leads to higher speeds. Except on limited access highways (i.e. freeways), widening and straightening roads does not increase safety. “Wider and straighter roadways lead motorists to travel at higher speeds, thus offsetting any safety benefits associated with increased sight distances” (Dumbaugh et al., 2009, citing Aschenbrenner & Biehl, 1994; Wilde, 1994).

Dumbaugh et al. (2009) breaks the problem down into its constituent parts, (1) crash incidence and (2) crash severity:

“The safety problem with urban arterials can best be understood as a product of systematic design error. Widening and straightening these roadways to increase sight distances also has the effect of enabling higher operating speeds, which in turn increase stopping sight distance, or the distance a vehicle travels from the time when a driver initially observes a hazard, to the time when he or she can bring the vehicle to a complete stop. Higher stopping sight distances pose little problem when vehicles are traveling at relatively uniform speeds and have few reasons for braking. When these operating conditions can be met, as they are on grade-separated freeways, higher operating speeds have little or no effect on crash incidence.

“But these operating conditions typically cannot be met on urban surface streets, where pedestrians, bicyclists, and crossing vehicles are all embedded in the traffic mix. Avoiding crashes under these conditions often requires motorists to bring their vehicles to a quick stop, which higher operating speeds and stopping sight distances make more difficult (Dumbaugh, 2005b; 2006. . .). The result is a systematic pattern of error in which drivers are unable to adequately respond to others entering the roadway, leading to increased crash incidence.”

Dumbaugh et al. also points out that speed reduction requires design features and/or commercial vibrancy and activity that provide cues to motorists to slow their vehicle’s speed, rather than simply a slower posted speed limit:

“...Placing commercial uses on arterial thoroughfares created a pedestrian safety problem... In practice, the solution to this problem in the United States has been to continue to locate such uses on arterial thoroughfares, but to reduce posted speed limits. In the absence of aggressive police enforcement, however, such practices have been uniformly unsuccessful at reducing vehicle operating speeds (Armour, 1986; Beenstock, Gafni, & Goldin, 2001; Zaal, 1994). The principal alternative, adopted by European designers, is to design urban surface streets to reduce vehicle speeds to safe levels.

“We found pedestrian-scaled retail (the type of retail that was abandoned during the postwar period) to be associated with reductions in all types of crashes, and at significant levels for both total and injurious crashes. This is consistent with recent research on the subject, which finds that the pedestrian-scaled nature of these environments communicate to motorists that greater caution is warranted, leading to increased driver vigilance, lower operating speeds, and thus a better preparedness to respond to potential crash hazards that may emerge. The effective result is a reduction in crash incidence (Dumbaugh, 2005a; 2005b; 2006b; Garder, 2004; Naderi, 2003; Ossenbruggen, Pendharkar & Ivan, 2001)” (Dumbaugh et al. 2009, p. 323).

Dumbaugh et al. concludes that, except for limited-access freeways, reducing speeds is essential for safety, and also helps create livability:

“In areas where pedestrian activity is present or expected, or where eliminating a roadway’s access function [to businesses, residences, jobs, etc.] is either undesirable or inappropriate, the primary alternative to access management is to reduce operating speeds to levels that are compatible with the street’s access-related functions (see Figure 8). This approach, sometimes referred to as the livable street approach, incorporates design features that encourage lower operating speeds, such as making buildings front on the street, incorporating aesthetic street lighting or landscaping along the roadside, enhancing the visual quality of pavement and signage, and adopting traffic calming or intersection control measures. In short, livable streets emphasize access over mobility. When compared to conventional arterial treatments, livable streets report roughly 35–40% fewer crashes per mile traveled, and completely eliminate traffic-related fatalities (Dumbaugh, 2005a; Naderi, 2003)” (Dumbaugh, 2009, p. 325).

Providing greater clear space around a roadway, e.g. wider shoulders or clearing trees, can lead to degraded driver attention, in addition to higher speeds. “In dense urban areas, less-“forgiving” design treatments—such as narrow lanes, traffic-calming measures, and street trees close to the roadway—appear to enhance a roadway’s safety performance when compared to more conventional roadway designs. The reason for this apparent anomaly may be that less-forgiving designs provide drivers with clear information on safe and appropriate operating speeds” (Ewing and Dumbaugh, 2009). Greater accommodation of driver error especially increases risk to vulnerable road users such as pedestrians and cyclists.

Lane width has a particularly discernable impact on safety. The traditional approach to sizing lanes opts for wider lanes to accommodate driver error and to attempt to increase throughput. However, research reveals that wider lanes hinder both of these objectives. Karim (2015) examined the relationship between lane width and crash rates. A number of findings were corroborated across cities:

- Wider lanes (over 10.8 to 11.2 feet) are associated with 33% higher impact speeds and higher crash rates.
- Both narrow (less than 9.2 feet) and wide (over 10.2 to 10.5 feet) lanes have proven to increase crash risks, with equal magnitude. Wider lanes (wider than 10.8 feet) adversely affect overall side-impact collisions.
- The overall capacity of narrower lanes is higher.
- For large vehicles, no difference on safety and carrying capacity is observed between narrower and wider lanes.
- Pedestrian volumes decline as lanes widen.
- Intersections with narrower lanes provide the highest capacity for bicycles.

The study finds that the street environment impacts driver behavior, and narrower lanes in urban areas result in less aggressive driving and more ability to slow or stop a vehicle over a short distance to avoid collision. It also points out that co-benefits of narrower lanes include utilization of space to provide an enhanced public realm, including cycling facilities and wider sidewalks, or to save money on the asphalt not used by motorists (Karim, 2015).

Yeo et al (2014) summarizes past studies that show both reducing intersection density and widening traffic lanes to worsen safety:

“Wider traffic lanes turn out to be the reason for a higher risk of fatal crashes (Noland and Oh 2004), whereas a street with a narrower curb-to-curb distance is relatively safe (Gattis and Watts 1999). Areas with a high level of intersection density also tend to have fewer fatal crashes (Ladron de Guevara et al. 2004). According to Ewing and Dumbaugh (2009), the aforementioned road designs and street patterns create a less forgiving environment for drivers and thus help decrease traffic speed” (Yeo et al., 2014, p. 402).

Numerous studies found that narrowing lanes from today’s standard practice would improve safety. However, one multi-state study found three specific circumstances where narrower lanes did not increase safety in all states studied, but only some of them. The following is provided as a caveat:

“The research found three situations in which the observed lane width effect was inconsistent—increasing crash frequency with decreasing lane width in one state and the opposite effect in another state. These three situations are:

- Lane widths of 10 feet or less on four-lane undivided arterials.
- Lane widths of 9 feet or less on four-lane divided arterials.
- Lane width of 10 feet or less on approaches to four-leg STOP-controlled arterial intersections.

“Because of the inconsistent findings mentioned above, it should not be inferred that the use of narrower lane must be avoided in these situations. Rather, it is recommended that narrower lane widths be used cautiously in these situations unless local experience indicates otherwise” (Potts, et al. 2007).

Protecting Vulnerable Road Users

To the extent that a lead agencies address safety in a CEQA analysis, the focus must be on protecting people. Thus, for example, lead agencies might analyze how a land use project or transportation infrastructure project that increases traffic speeds may burden its travel-shed with additional, undue risk. These risks might be mitigated by, for example, (1) reducing motor vehicle travel speeds, (2) increasing driver attention, (3) protecting vulnerable road users (e.g. providing a protected, Class IV bicycle path and/or shortening pedestrian crossing distances and providing pedestrian refuges and bulb-outs), or (4) reducing VMT by providing VMT mitigation. Mitigation should avoid creating additional risk to vulnerable road users and it should not reduce active transportation mode accessibility or connectivity.

Generally speaking, the safety of vulnerable road users (e.g. pedestrians and bicyclists) should be given relatively more attention, due to their vastly increased risk of serious injury and fatality. Also, policy and planning priorities to encourage multimodal and low-carbon travel, and improving safety is a key step in increasing use of those modes. Where there are safety tradeoffs, therefore, it is important to prioritize protection of vulnerable road users. Impacts to potential vulnerable road users should be considered whether or not specific facilities for those users are present.

Active transportation has substantial health benefits, so restricting pedestrian or bicycle access and connectivity in order to reduce collision risk may worsen overall health outcomes. And, any decision about whether to apply a safety measure that restricts access by pedestrians and cyclists should consider (1) the reduction in walking and biking that will result, and the

resulting reduction in “safety in numbers” as well as overall health, and (2) the risk created by pedestrians or cyclists subverting the design purpose for convenience (e.g. crossing a street where prohibited) that might lead to additional safety risk.

Reducing overall VMT and Sprawl

Higher total amounts of motor vehicle travel create higher crash exposure. Reducing vehicle miles traveled reduces collision exposure and improves safety (Dumbaugh and Rae, 2009, p. 325; Ewing, Scheiber, and Zegeer, 2003). As a result, infill development, which exhibits low VMT, itself provides safety benefits by reducing motor vehicle collision exposure, lowering speeds, and increasing pedestrian and cyclist volumes leading to “safety in numbers” (in addition to improving overall health broadly and substantially).

The fundamental relationship between VMT and safety is summarized by Yeo et al. (2014):

“Multiple traffic safety studies showed that higher VMT was positively associated with the occurrence of traffic crashes or fatalities (e.g., Ewing et al. 2002, 2003; NHTSA 2011). The causal relationship between the mileage of total vehicle trips and crash occurrences can be explained by probability. With higher VMT, it is more likely that more crashes will occur (Jang et al. 2012).”

Sprawl-style development has also been shown to lead to elevated crash risk. The cause lies both in higher VMT levels and in design variables which influence speed and driver behavior (Yeo 2014). Ewing et al. (2003) points out that “[s]uburban and outlying intersections have been significantly overrepresented in pedestrian crashes compared with more urban areas, after control for exposure and other location factors.”

More generally, Ewing et al. (2003) reveals that sprawl development (measured by (1) lowness of density, (2) lack of mixing of uses, (3) absence of thriving activity centers such as strong downtowns or suburban town centers, and (4) largeness of block sizes and poorness of street connectivity) leads to elevated transportation risk levels:

“Our study indicates that sprawl is a significant risk factor for traffic fatalities, especially for pedestrians. The recognition of this relationship is key; traffic safety can be added to the other health risks associated with urban sprawl—namely, physical inactivity and air and water pollution.

“... Sprawling areas tend to have wide, long streets that encourage excessive speed. A pedestrian struck by a motor vehicle traveling at 40 mph has an 85% chance of being killed, compared with a 45% chance of death at 30 mph and a 5% chance at 20 mph. Thus, developing land in a more compact manner may reduce pedestrian deaths, provided that the street network is designed for lower-speed travel.”

Ewing et al. (2003) further demonstrates that, on the whole, counties characterized by the most sprawling land use patterns exhibit substantially higher crash risk (between four and five times the all-mode fatality rate) compared to the most compact counties:

TABLE 2: US COUNTIES WITH HIGHEST AND LOWEST SPRAWL INDEX VOLUMES

	County	Metropolitan Area	Sprawl Index ^a	All-Mode Traffic Fatality Rate (per 100 000)
1	New York County, NY	New York	352.07	4.42
2	Kings County, NY	New York	263.65	4.46
3	Bronx County, NY	New York	250.72	4.20
4	Queens County, NY	New York	218.90	4.58
5	San Francisco County, Calif	San Francisco	209.27	6.31
6	Hudson County, NJ	Jersey City	190.06	5.91
7	Philadelphia County, Pa	Philadelphia	187.78	8.04
8	Suffolk County, Mass	Boston–Lawrence–Salem	179.37	4.49
9	Richmond County, NY	New York	162.89	5.63
10	Baltimore City, Md	Baltimore	162.76	7.68
439	Stokes County, NC	Greensboro–Winston-Salem–High Point	71.26	15.66
440	Miami County, Kans	Kansas City	71.03	38.80
441	Davie County, NC	Greensboro–Winston-Salem–High Point	70.99	25.84
442	Isanti County, Minn	Minneapolis–St Paul	70.12	12.78
443	Walton County, Ga	Atlanta	69.61	19.77
444	Yadkin County, NC	Greensboro–Winston-Salem–High Point	69.17	38.52
445	Goochland County, Va	Richmond–Petersburg	67.59	35.58
446	Fulton County, Ohio	Toledo	66.83	38.02
447	Clinton County, Mich	Lansing–East Lansing	66.63	16.99
448	Geauga County, Ohio	Cleveland	63.12	20.90

^aHigher values of the index indicate more compact urban form; lower values indicate more sprawling urban form.

Source: Ewing et al., 2003

Beyond crash incidence rates and severity, delay in receiving medical care after a crash contributes to worse health outcomes from transportation safety in sprawling neighborhoods. Traditional impact analysis focuses on congestion as an inhibitor to emergency responses times. However, research shows that emergency response suffers more from greater distances to destinations found in sprawling areas than from congestion in compact and congested areas:

“Emergency medical service (EMS) delay is another possible mediator that could help explain the direct non-VMT-involved sprawl effect on traffic fatalities. Urban sprawl increases EMS waiting time, and delay in ambulance arrival can increase the severity of traffic-related injuries (Trowbridge et al. 2009). ‘For every 10% increase in population density’ . . . the models estimated by Lambert and Meyer (2006, 2008) predict ‘a 10.4% decrease in EMS run time’ in the Southeastern United States and nationwide ‘an average 0.61 percent decrease in average EMS run time’” (Yeo et. al, 2014).

Collectively, research points to an approach on safety that aligns well with other state priorities and laws (e.g. infill priority, greenhouse gas reduction), as well as with the visions of many local jurisdictions for their own growth. Compact infill development, in addition to providing livable and vibrant neighborhoods, walkable communities, environmental benefits, land conservation, fiscal benefit and cost reduction for citizens, also improves traffic safety:

“Our study, which addresses the built environment in a more comprehensive manner [than past studies], found population density to be associated with significantly fewer total and injurious crashes. . . . Individuals living in higher density environments drive less (Ewing & Cervero, 2001), thus reducing their overall exposure to crashes. When these reductions in VMT are aggregated across a larger population, they can potentially add up to notable reductions in population-level crash incidence” (Dumbaugh and Rae, 2009).

“[Our] research findings suggest that enhancing traffic safety by reducing fatalities can be achieved by fighting against urban sprawl and promoting smart growth countermeasures. It will be important to revive city centers, to increase density, and to provide for mixed land uses. Urban design solutions that can enhance walkability at the meso- and microlevels may help reduce traffic fatalities” (Yeo et. al, 2014).

Attribution of Safety Impacts

Some safety impacts result from the effects of many past projects accumulated over time. An infill project, for example, may add an additional vehicle to a queue in a turn pocket or on a ramp causing it to extend into mainline traffic. Such an impact is the cumulative effect of many projects. In any case, vehicle queueing resulting from a particular project frequently cannot be estimated accurately, especially where traffic is affected by many factors. Typical modeling error on traffic volumes at an intersection can reach 40 percent, and microsimulation performed to estimate queue lengths introduce further error. Other factors affect travel demand (e.g. the economy, the price of gasoline). Therefore, it is frequently impossible to meaningfully predict whether the direct effect of a development in an infill area will be the cause of a vehicle queue extending onto a highway mainline.

Meanwhile, if a development generates or attracts such large amounts of automobile travel that it contributes a substantial portion of the traffic that leads to a queue onto the mainline, attributing that proportion of the associated risk to that project would be appropriate. This might be particularly so on the urban periphery where that traffic would be easily attributable to the project.

Addressing Tradeoffs and Finding Win-Win Safety Improvements

Traditional solutions for safety risks sometimes create other safety risks, impact human health in other ways, and sometimes are at cross purposes with other state and community interests such infill priority, greenhouse gas reduction, cost reduction, or access to destinations. When addressing safety impacts, a jurisdiction should frame and address those risks in a manner that helps forward the community’s overall goals, while improving safety. Some modern approaches to reducing safety risk, developed over the past decade or two based on research, allow all safety to be improved while meeting these other goals. Here are three examples:

- (1) A queue extending out of a turn pocket or off ramp can increase the risk of rear-end collisions. However, addressing that risk by adding additional vehicle capacity such as a second lane will lead to additional risk for pedestrian crossing. Addressing that risk by adding extra green time in the traffic signal timing will lead to shorter pedestrian crossing times and/or

additional pedestrian wait time. Addressing these secondary risks by prohibiting pedestrian crossing will reduce connectivity of the pedestrian network, leading to reduced pedestrian mode share, which will increase risk by decreasing “safety in numbers” benefits and impact the health benefits associated with active mode travel. Meanwhile, improving safety with street design features that lower travel speeds to reduce crash incidence and severity can improve walkability.

- (2) Surface roadway lanes can be redesigned from traditional 12.0 foot widths to with 9.2 to 10.8 foot widths with little or no down-side. Such a narrowing of lanes maintains motor vehicle capacity, increases bicycle capacity, maintains large vehicle capacity and safety, improves pedestrian crossings safety and comfort, increases pedestrian volumes, improves driver attention, decreases crash rates, decreases crash severity, reduces construction costs, reduces maintenance costs, reduces impermeable surface area, reduces construction and maintenance air quality and GHG emissions, and reduces space consumption (Karim, 2015).
- (3) Improving safety by adding signage and pavement markings that help reduce speeds and increase pedestrian visibility can have an array of benefits, including:
 - Decrease in crash incidence for all users, including vulnerable road users
 - Decrease in crash severity for all users, including vulnerable road users
 - Increase safety and comfort for pedestrians and cyclists, resulting in increased walking and biking mode share, in turn increasing safety in numbers effects for vulnerable road users and improving public health both via improved safety and increased physical activity.

While reductions in automobile speed may initially increase auto mode travel times, improving conditions for pedestrians and cyclists can lead to finer grain land use development over time, and ultimately improve destination proximity and overall access to destinations.

Examples and Mischaracterizations of Detriments to Overall Safety

The following are examples of possible detriments to overall safety if not mitigated:

- An increase in VMT. More vehicle travel exposes motorists and other road users to more crash risk
- An increase in pedestrian wait times. Many studies have found that pedestrian wait times play a role in crashes. Long wait times increase the risk some pedestrians will cross against a signal, creating a vulnerable road user collision risk (FHWA-RD-03-042, 2004)
- Site design elements that would create hazardous conditions for vulnerable road users
- Substantially increasing motor vehicle speeds, or increasing them to greater than 25 miles per hour where vulnerable road users are present without providing proper infrastructure for vulnerable road users (e.g. Class IV bikeways for cyclists)
- Substantially increasing intersection pedestrian crossing distances, e.g. for addition of a through or turn lane
- Signal lengths of greater than 90 seconds, which may lead to people crossing on a red signal with a gap in the vehicle platoons
- Increase in curb radius

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- Installation of large curb radii, promoting higher speed motor vehicle turning movements, particularly endangering pedestrians and cyclists
 - Addition or widening of on- and off-ramps where they meet surface roadways that increases pedestrian crossing distances or times, increase pedestrian wait times, or lead to a prohibition of pedestrian crossing
 - Addition or widening of off-ramps in a manner that leads to higher speeds on surface streets
 - Excessively large clearance zones along shoulders
 - Wider than needed travel lanes (e.g. wider than 10.8 feet on surface streets)
 - Multiple turn lanes at an intersection (e.g. a double left or double right turn lane)
 - Placement of driveways in locations which will lead to highly elevated collision risk
 - Excessively large driveways across sidewalks
 - Substantially increased distances between pedestrian and bicycle crossings
 - Roadway design speed (regardless of posted speed limit) that leads to actual speeds that are unsafe for cyclists and pedestrians

Safety issues can be mischaracterized with overly narrow perspective or traditional design guidance that has not been updated to reflect research. The following are examples of mischaracterizations of safety issues

- Avoidance of installation of corner or mid-block crossings to avoid additional pedestrian traffic and conflict with vehicles (reduces pedestrian mode share, undoing safety in numbers)
- Avoidance of narrow (e.g. 10 foot) travel lanes on surface roadways (see discussion above)
- Avoidance of implementing sidewalk bulbs, widened sidewalks, parklets, or other curb extensions or removal of on-street parking for fear of exposing vulnerable users to vehicular traffic (these features slow traffic and improve walkability as discussed above)
- Addressing off-ramp queuing by limiting stop control on an exit ramp (this can lead to vehicles flowing unimpeded and at high speeds onto a local street, increasing risk for all road users)
- Avoidance of protected bicycle facilities adjacent to transit boarding islands to avoid conflicts between transit users and cyclists (this is safe with good design)
- Maintaining or providing parking spaces out of concern that road rage could result from traffic congestion or circling for parking as an outcome of the removal of on- or off-street parking spaces (adding parking increases VMT and overall crash exposure)

Examples of Potential Transportation Safety Mitigation Measures

- Intersection improvements
 - » Visibility improvement

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- » Shortening corner radii
 - » Pedestrian safety islands
 - » Accounting for pedestrian desire lines
 - Signal changes
 - » Reducing signal cycle lengths to less than 90 seconds to avoid pedestrian crossings against the signal
 - » Providing a leading pedestrian interval
 - » Provide a “scramble” signal phase where appropriate
 - Roadway improvements
 - » Add curb extensions or bulb-outs
 - » Add bicycle facilities (On higher speed roads, add protected bicycle facilities)
 - » Reduce travel lane width below 10.8 feet (but not below 9.2 feet)
 - » Add traffic calming measures
 - » Add landscaping features
 - Network improvements
 - » Provide shorter blocks
 - » Provide mid-block crossings
 - Reduce VMT
 - » Increase density and/or diversity of land uses
 - » Provide travel demand management measures
 - » Provide transit
 - » Provide pedestrian facilities
 - » Provide bicycle facilities

Mitigation and Alternatives

When a lead agency identifies a significant impact, it must consider mitigation measures that would reduce that impact. The selection of particular mitigation measures, however, is always left to the discretion of the lead agency. Further, OPR expects that agencies will continue to innovate and find new ways to reduce vehicular travel. Several potential mitigation measures and

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alternatives to reduce vehicle miles traveled are described below. Notably, the suggested mitigation measures and alternatives were largely drawn from the California Air Pollution Control Officers Association's guide on [Quantifying Greenhouse Gas Mitigation Measures](#). That guide relied on peer-reviewed research on the effects of various mitigation measures, and provides substantial evidence that the identified measures are likely to lead to quantifiable reductions in vehicle miles traveled.

Potential measures to reduce vehicle miles traveled include, but are not limited to:

- Improve or increasing access to transit
- Increase access to common goods and services, such as groceries, schools, and daycare
- Incorporate affordable housing into the project
- Incorporate neighborhood electric vehicle network
- Orient the project toward transit, bicycle and pedestrian facilities
- Improve pedestrian or bicycle networks, or transit service
- Provide traffic calming
- Provide bicycle parking
- Limit or eliminating parking supply
- Unbundle parking costs
- Provide parking or roadway pricing or cash-out programs
- Implement or provide access to a commute reduction program
- Provide car-sharing, bike sharing, and ride-sharing programs
- Provide transit passes

Examples of project alternatives that may reduce vehicle miles traveled include, but are not limited to:

- Locate the project in an area of the region that already exhibits low vehicle miles traveled
- Locate the project near transit
- Increase project density
- Increase the mix of uses within the project, or within the project's surroundings
- Increase connectivity and/or intersection density on the project site
- Deploy management (e.g. pricing, vehicle occupancy requirements) on roadways or roadway lanes

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