

Road Diets: Fitter, Healthier Public Ways

September 2013

This briefing note introduces the road diet, an engineering technique that reallocates space on a street or road for other uses when they are over-built and have excess lanes. In what follows, we will present a definition, some study results and practical implementation considerations for road diets.

When applied with consideration for contextual details, it is generally agreed that road diets provide significant safety benefits for motorists, cyclists and pedestrians alike.

With fewer and narrower lanes, the crossing distances for pedestrians are shorter, vehicle speeds come down to more appropriate levels, and protected space for cyclists is created. Road diets are most successful on streets carrying average annual daily traffic (AADT) of up to 12,000, but can be implemented on streets with higher volumes if intersections are studied and configured carefully.

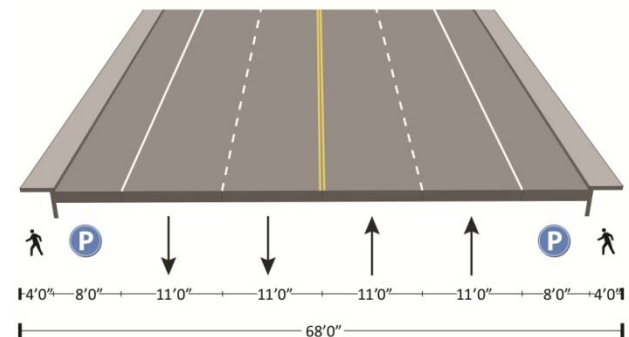
Because much of the opposition to road diets stems from misconceptions about the function of the roadway after lanes are reallocated, thoughtful messaging is needed to communicate the ways in which road diets improve the safety of the road for all.

What is a Road Diet?

In 1999, Dan Burden and Peter Lagerwey coined the term “road diet” to explain road conversion measures to “right-size” travel lanes and to remove excess lanes from streets.¹ A road diet typically involves converting an undivided four lane roadway into three lanes, made up of two through lanes and a centre two-way left turn lane. However, road diets have been completed on

roadways comprising more lanes, and the number of lanes remaining after interventions can vary. What is constant is that the reduction of the number of lanes and/or lane widths allows the roadway space to be reallocated for other uses such as bike lanes, pedestrian crossing islands, buffered sidewalks, and/or parking.

Before Road Diet



After Road Diet

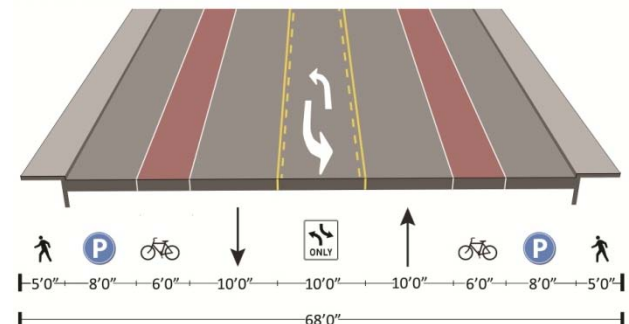


Figure 1 Before and after a road diet

A road diet re-allocates the existing right-of-way to better support all modes of transportation: pedestrians, cyclists, motorists, transit and freight/delivery. When converting a four lane roadway to three, a road will have one vehicle travel lane in each direction. This allows a prudent driver to set the prevailing speed for all cars following that driver. On-street parking and comfortably wide bike lanes create buffers of two kinds—between motorists and the edge of the road, and between pedestrians and moving traffic. The centre lane can be used for left turns, to allow emergency responders to pass, for pedestrian refuge crossing islands or for delivery bays.

Note: The values in this figure are in feet. The conversion is: 1 foot = 0.30 metres.

Source: Walkable and Livable Communities Institute (WALC Institute).

¹ Dan Burden is a co-founder and the executive director of the Walkable and Livable Communities Institute (WALC Institute), a U.S.-based not-for-profit organization dedicated to education and community engagement by focusing on changes to the built environment that promote active modes of transportation. Peter Lagerwey is the Regional Office Director for Toole Design Group, a private consulting group in transportation and urban planning based in the United States.

Methods

Since 1999, numerous studies on the effects of road diets have been undertaken. This fact sheet includes all the identified evaluations of road-diet interventions. The project team worked from the available literature. It also contacted Peter Lagerwey for updated materials on road diet performance and learned that while no current study exists, Mr. Lagerwey is conducting a comprehensive study on the performance of road diets in 2012-2013. Additionally, the project team contacted Dr. Carol H. Tan, Team Leader of Safety Management for the Office of Safety Research and Development of the U.S. Department of Transportation Federal Highway Administration (FHWA), to learn whether additional data on road diet performance exist. Dr. Tan confirmed that the project team was using current findings and noted that in 2012, the FHWA issued a technical memorandum with nine proven countermeasures to improve roadway safety; road diets were on this list (Furst, 2012). Finally, research officers from the National Collaborating Centre for Healthy Public Policy (NCCHPP) conducted a search using the federated search engine 360² and Google Scholar, using the expression “road diet.” The evaluations identified and used are referenced at the end of this document.

Evaluations of road diets have focused on road safety issues. Despite variations in the interventions studied and in the evaluative methods mobilized, these studies indicate positive outcomes. Although we feel the research in general leaves little room for doubt on the benefits of road diets for road safety, we nonetheless urge the reader to be careful in the interpretation of the results presented. A road diet intervention is context sensitive. Therefore, the results are likely to reflect the types and combination of treatments employed in any one case studied. Further, design decisions are, and should be, based

² This search by the Serials Solution search engine covered the following databases: BioMedCentral, Cambridge Journals Online, CINAHL, EMBASE (1980 to Present), Environmental Sciences & Pollution Management, Érudit, HighWire Press, ipl2 – Internet Public Library, Journals@Ovid LWW Total Access Collection, MEDLINE (Ovid), MEDLINE Plus Health Information, MEDLINE with Full Text (EBSCO), MetaPress Complete, Nature Journals Online, OAister, PILOTS, Political Science Complete, Psychology & Behavioral Sciences Collection, PsycINFO 1887-Current, Public Affairs Index, PubMed, PubMed Central, ScienceDirect, ScienceDirect Journals, Scirus, Social Services Abstracts, SocINDEX with Full Text (EBSCO), Sociological Abstracts, Sociology, Wikipedia, Wiley InterScience Journals.

on the community’s desired level of service for all modes of transportation, and the results of interventions and their evaluations are likely to be different because of variations in that regard as well.

Road Diets: How They Work

In their article, titled *Road Diets: Fixing the Big Roads*, Burden and Lagerwey noted the dangers of the four lane undivided highway: speeding, unpredictable behaviour, rear-end and side-swipe collisions, increased severity of injuries from collisions, and blind spots. They also noted how, pre-road diet, the corridor often discouraged active transportation due to high speeds and numerous conflict points between pedestrians, cyclists and vehicles (Burden & Lagerwey, 1999). Indeed, 4-lane undivided highways are particularly dangerous to pedestrians because of the potential for multiple-threat crashes, in which one vehicle stops and screens the pedestrian, while another motorist continues on in the through lane.

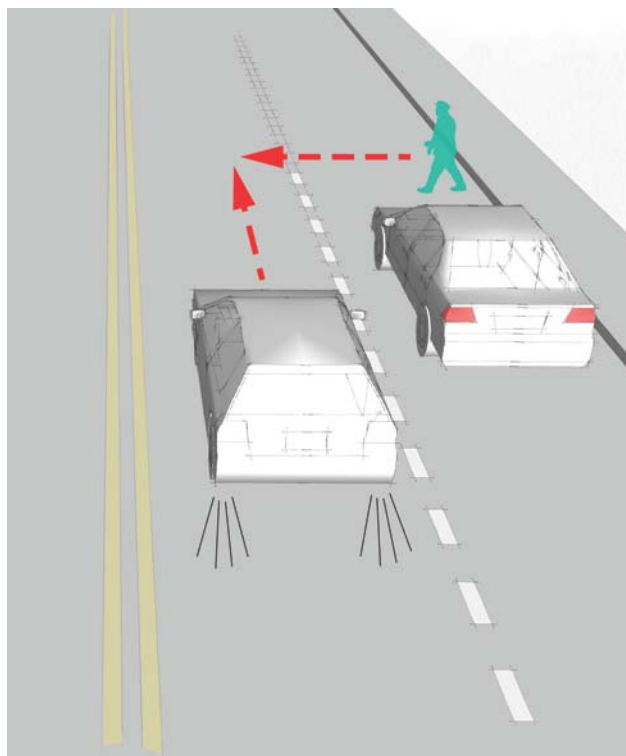


Figure 2 Less conflict, more visibility

A three-lane cross section produces fewer conflict points between vehicles and crossing pedestrians. In addition, although the total roadway width does not change, the complexity of the pedestrian crossing manoeuvre is reduced.

Source: WALC Institute.

The pedestrian and motorist cannot see each other, and the fact that the motorist in one lane has stopped to allow the crossing does not necessarily mean that the motorist in the next lane can see the pedestrian or will respond in the same way.

Road diets, also called “right-sizing” of roads, reallocate existing public right of ways. When excess lanes are removed and lane widths are narrowed to 10–12 feet (3.0–3.7 m), the existing right of way can be allocated to support all modes. Because drivers base their travel speeds on what feels comfortable given the street design, lane width reductions and the removal of excess travel lanes have an effect both on speeds and collision rates, since the number and severity of collisions tend to increase with increased speed. In general, the wider the road in front of us, the faster we tend to drive. The faster a car is going, the more severe the injuries in the event of a collision.

In a study of design factors that affect driver speed on suburban arterials, a lane-width reduction from 12 feet to 11 feet (3.7 m to 3.4 m) correlated with a 3 km/h reduction in speed, and a lane reduction from 12 feet to 10 feet (3.7 m to 3 m) with an 11 km/h reduction in speed (Transportation Research Board, 1994). Wider lanes encourage faster driving. Wide roads also pose problems for pedestrians. The wider a roadway, the farther a pedestrian has to cross, and the longer the pedestrian is exposed to the threat of a collision.

Research suggests that the number of collision injuries can increase significantly—by as much as 487 percent—with additional lane width on residential streets (Swift, Painter, & Goldstein, 2006).

After a road diet, one vehicle travel lane in each direction allows a prudent driver to set the prevailing speed for all cars following that driver. On-street

parking and comfortably wide bike lanes create buffers of two kinds—both between motorists and the edge of the road, and between pedestrians and moving traffic. A road diet allows for the construction of a “complete street” that provides safe and equal access for users of all ages and abilities.

Conditions of Road Diets: Types and contexts of streets, flow and volumes of cars

Reconfiguring a roadway for both lane and lane-width reductions depends on the current configuration and desired operational and safety outcomes. The majority of four-lane roadways were built or widened to accommodate daily peak vehicle traffic volumes, but for the remaining hours, there is excess capacity. When considering a candidate for a road diet, there is no definitive set of criteria that can determine viability. The guidelines below thus present general characteristics of streets where road diets have been successfully implemented.

Traffic Volumes

Road diets have been successfully implemented on streets carrying a wide variety of average annual daily traffic (AADT) volumes. Ranges from 8,000 to 15,000 are generally considered to be good candidates for road diets (Burden & Lagerwey, 1999). Four-lane undivided roadways with an AADT between 8,400 and 24,000, and a relatively wide range of traffic flow have been successfully converted to three-lane cross sections in many areas of the United States (Knapp, 2003). However, for road diets with AADTs above approximately 20,000 vehicles, there is a greater likelihood that traffic congestion will increase to the point of diverting traffic to alternate routes (Huang, 2002). When road diets are being considered on streets whose AADT exceeds 20,000, signalized intersections should be studied and possibly upgraded to roundabouts to reduce vehicle congestion and diversion.

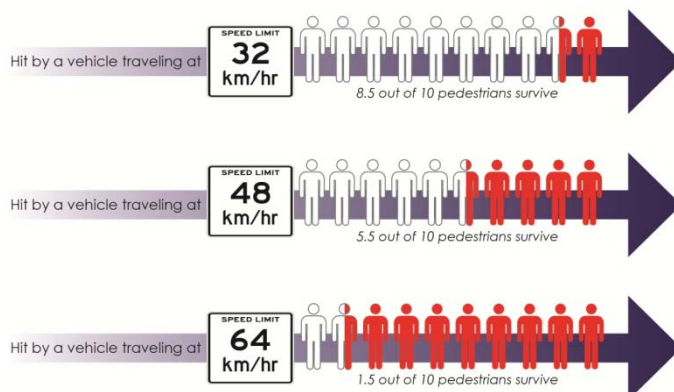


Figure 3 Collision speed and pedestrians' survival rate: reduced speed is significantly better

The graphic shows pedestrians' likely survival rate if hit by a vehicle. Between 30 km/h and 60 km/h, the rate goes down exponentially.

Source: WALC Institute, based on data from UK Department of Transport, 1987, 1994.

Missing Infrastructure to Support All Modes

If a roadway does not provide sufficient infrastructure for other modes of transportation, a road diet may create the extra space needed to provide or improve infrastructure for cyclists, pedestrians, or transit riders. Bicycle infrastructure should be considered if bike lanes are missing or too narrow, especially if the corridor is a popular or essential bicycle route or system. If sidewalks are too narrow or if they are missing on one or both sides of the street, a road diet allows for improvement. Pedestrian crossings can be improved with a road diet, as well. A road diet should be considered if pedestrians have difficulty finding gaps in four-lane traffic to cross the roadway. Bus, trolley, or other transit service along a corridor can also make it a good candidate for a road diet.

Surrounding Land Uses

Roadways in areas with surrounding land uses that attract pedestrians, cyclists, visitors, and residents are also good road-diet candidates. These can include historic streets, scenic drives, main streets, streets with schools, or roads in an entertainment district. Four-lane undivided highways often encourage drive-through behaviour for motorists, rather than the desire to stop, park or spend time in the area.

Some study results

- Road-diet conversion case studies show both a reduction of average speeds and a dramatic reduction in excessive speeding (Knapp & Rosales, 2007).
- Overall collisions on conversions studied were reduced by 17–62% post-road diet, an extremely high reduction rate for a single traffic-calming tool (Knapp, Giese, & Lee 2003).
- Where crashes did still occur post-road diet on the conversions studied, involvement of at-risk age groups—under 25 and over 65 years of age—was reduced (Stout, Pawlovich, Souleyrette, & Carriquiry, 2006).
- A 2001 study found a reduction in pedestrian crash risk when crossing two- and three-lane roads compared to roads with four or more lanes (Zegeer, 2001).

Other Considerations

Road diets may also be considered if the following conditions exist:

- A high number of left-turning movements
- Roads with safety issues or high crash rates
- Availability of transit
- Proximity to schools or hospitals
- The road diet features will better integrate with adjacent roadway segments
- Support of the community is in place.

Because a complete street can be provided within the existing right-of-way after removing or narrowing vehicle travel lanes, road diets are less expensive than widening roads, have fewer negative impacts on adjacent properties, and interrupt traffic for less time during the conversion than a road-widening project would (Knapp, 2001).

Road Diets: Study Results

Studies on road diets have focused mainly on road safety issues and related outcomes. Evaluations have mostly concentrated their attention on their effects on the speed of motorized vehicles, on collisions and on their consequences in terms of morbidity and mortality. In this section, we summarize the available research.

Safety data indicates that three-lane roadways have lower collision rates than four-lane undivided roadways in medium and high-density residential and commercial land use areas (Knapp, Giese, & Lee, 2003). In addition, according to researchers at North Carolina State University, unlike the two-lane and four-lane undivided roadways, the collision rates of three-lane roadways did not seem to increase with development density (Knapp, 2001).

A comprehensive appraisal of various safety engineering measures was performed under the auspices of the National Cooperative Research Program. Among the list of measures appraised are road diet interventions. Consisting of a re-analysis of the data used in existing studies that had yielded inconsistent results, it integrated the original and

Table 1 Before and after collision data per mile in Iowa and HSIS studies (Washington and California)

<i>Database/Site Type</i>	<i>Characteristic</i>	<i>Mean</i>	<i>Minimum</i>	<i>Maximum</i>
Iowa Treatment (15 sites)	Crashes/mile-year before	23.74	4.91	56.15
	Crashes/mile-year after	12.19	2.27	30.48
	AADT before	7,987	4,854	11,846
	AADT after	9,212	3,718	13,908
	Average length (mi)	1.02	0.24	1.72
HSIS Treatment (30 sites)	Crashes/mile-year before	28.57	0	111.1
	Crashes/mile-year after	24.07	0	107.62
	AADT before	11,928	5,500	24,000
	AADT after	12,790	6,194	26,376
	Average length (mi)	0.84	0.08	2.54

Source: WALC Institute, adapted from Federal Highway Administration, 2010.

complementary data (to include more non-treated sites than the first studies had).³ The methodological approach used in this analysis was the Empirical Bayes Method.⁴ Further, it controlled for other road and traffic characteristics (such as speed limit and functional class) and used data from various jurisdictions, lessening the potential for error in estimates of the effects related to variance in road and traffic characteristics and in crash reporting practices.

The analysis, for which some of the main results have been summarized in Table 1, concluded that road diet interventions consisting of conversion from four lanes to three had resulted in collision reductions of 47% in the study sites in Iowa (IA) and 19% in both California (CA) and Washington states (WA). Commenting on these very different outcomes, the authors note that these differences:

- “May be a function of traffic volumes and characteristics of the urban environments where the road diets were implemented” because traffic volumes on the Iowa roads were considerably lower and in centres with smaller populations; and
- May also be due to a calming effect of the type observed in one Iowa site, an effect that “would be less likely in the larger cities in the [...] study where the approaching speed limits (and traffic speeds) might have been lower to start with” (Harkey et al., 2008, p. C-6).

These comments serve as a reminder that the anticipation of potential benefits has to be adjusted to the specificities of the interventions themselves, but also to that of their contexts and of the modifications they create in a given environment.

Data from Minnesota indicate that three-lane roadways have a collision rate 27% lower than the rates for four-lane undivided roadways. Researchers found that the monthly collision frequency decreased by between 2% and 42% after conversion from a four-lane undivided to three-lane cross-section (Huang, 2002). Collision severity also decreased, but the changes in collision type (between adjusted and comparable non-adjusted sites) were found to be similar. The expected increase in safety that results from a four-lane undivided to three-lane cross section conversion may primarily be the result of a reduction in speed and speed variability along the

³ The data were extracted from two databases, namely those of the Iowa Department of Transportation and the Highway Safety Information System (HSIS).

⁴ As some researchers have presented it: “This method makes it possible to take into account changes in traffic volume, the underlying trend in the number of collisions and the effects of regression to the mean (Persaud & Lyon, 2007). It uses data collected from control sites, the number and severity of collisions at the intervention sites before installation of the calming measures, and data concerning the evolution of traffic volumes to estimate, using regression models, the number and severity of collisions that could reasonably have been expected to occur without the installation of traffic-calming measures. The effectiveness of the intervention is then determined by comparing the number and severity of collisions having occurred since the intervention with those expected” (Bellefleur & Gagnon, 2011).

roadway, a decrease in the number of conflict points between vehicles, and improved sight distance for left-turning vehicles on major streets.

Final Thoughts: Addressing Concerns about Road Diets

If road diet interventions are to be successful, they need public and political support. Overly wide roads have been the norm in many places, and changing those norms requires capacity- and awareness-building among community members, elected officials and municipal leaders. The following concerns about proposed road diets might be raised and proponents will likely have to address them. As such, this section is in a question and answer format to anticipate these concerns.

If we go from four lanes down to two, what happens to half the traffic? Won't the road be terribly congested?

In most cases, traffic volumes on streets that reduce the number of travel lanes from four to two show no significant change. Under most average annual daily traffic (AADT) conditions tested, road diets have minimal effects on vehicle capacity, because left-turning vehicles are moved into a common two-way left-turn lane. Congestion may be lessened on a “road-dieted” street because turning cars can pull into turn pockets, leaving the through-lane clear. There is less jockeying back and forth for position. If the corridor is a bus route, buses can ease into the bike lane at stops, or dedicated bays, and allow cars to pass them in the through lane. Providing safe and comfortable spaces for walking and biking means some people may choose not to drive, putting fewer cars on the road in the first place.

Will surrounding neighbourhoods be plagued by cut-through traffic as drivers speed around the redesigned corridor?

In road-diet case studies, traffic diversion off of the study corridor has been a rare occurrence. However, for road diets with AADTs above approximately 20,000 vehicles, there is a greater likelihood that traffic congestion will increase to the point of diverting traffic to alternate routes (Huang, 2002). When road diets are being considered on streets whose AADT exceeds 20,000, signalized intersections should be studied and possibly upgraded to modern roundabouts to reduce vehicle

congestion and diversion. Where there is significant neighbourhood concern, a plan to implement neighbourhood traffic-calming measures concurrently with the road diet must be considered.

Will access to and from driveways or side streets be harder?

Turning onto the corridor can actually be easier, because there is only one lane of traffic in each direction to negotiate. If there is a centre left-turn lane, drivers turning left can cross one lane of traffic, then wait in the turn lane to merge into a gap in the travel lane. A 2008 study, *Safety Evaluation of Installing Center Two-Way Left-Turn Lanes on Two-Lane Roads*, demonstrated how adding a two-way centre turn lane to previous two-lane roadways in rural areas resulted in a 29% decrease in total crashes, a 19% reduction in injury collisions and a 36% reduction in rear-end crashes (Persaud et al., 2008).

Will emergency response times be slower?

On a four-lane road, when an emergency vehicle approaches, two lanes of cars must merge into one lane and then stop at the curb. After a road diet, the single lane of through traffic simply shifts into the bike lane and stops, allowing the emergency vehicle to pass in the through lane, or to use the centre lane.

Is investing money in non-motorized transportation wasteful when the roads are already in need of fixing?

Walking and cycling are actually often more efficient than driving for short trips, and walking is a component of many vehicle trips as well. When considered in terms of “effective speed”—the total time spent in travel, including time devoted to working in order to pay for vehicles and fares—non-motorized transport can often be compared advantageously to motorized transport (Litman, 2013). The Political Economy Research Institute (PERI), established in 1998, is an independent unit of the University of Massachusetts, Amherst, with close ties to the US Department of Economics. According to their study, bicycle projects yield 11.4 jobs per million dollars spent, versus 7.8 jobs created per million spent on road-widening projects (Heintz, 2009). The 2009 report titled *Bicycling Means Business: The Economic Benefits of Bicycle Infrastructure*, by the League of American Bicyclists and the Alliance for Biking and Walking, revealed

that bicycling brings in one billion dollars a year to Colorado's state economy, while bicycle-related activity in Portland, Oregon, contributes \$90 million to its local economy and provides 850 to 1,150 jobs. The report also noted the economic and health benefits of bicycling in Iowa. In 2009, that state's estimated 24,921 bicycle commuters generated \$51,965,317 in economic activity and provided health savings of \$13,266,020. Similar data are being captured in other states in the United States of America too. In 2009, the Minnesota Department of Employment and Economic Development found that cyclists were the second most active trail users in the state after walkers/hikers. The value of all goods and services produced in the state attributed to cyclists' spending came to \$261 million. This spending supported more than 5,000 jobs and helped generate \$35 million in taxes (Flushce, 2009).

Where can I learn more about road diets?

Founded in 1975, Project for Public Spaces is a New York City based nonprofit, dedicated to helping people create and sustain public spaces that build stronger communities.

Project for Public Spaces has created an online resource to explain how reconfiguring the layout of streets can create places that better serve communities. Through their Rightsizing Streets resource, Project for Public Spaces highlights communities large and small who are achieving impressive safety, mobility, and community outcomes by changing their street design.

See: <http://www.pps.org/reference/rightsizing/>

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