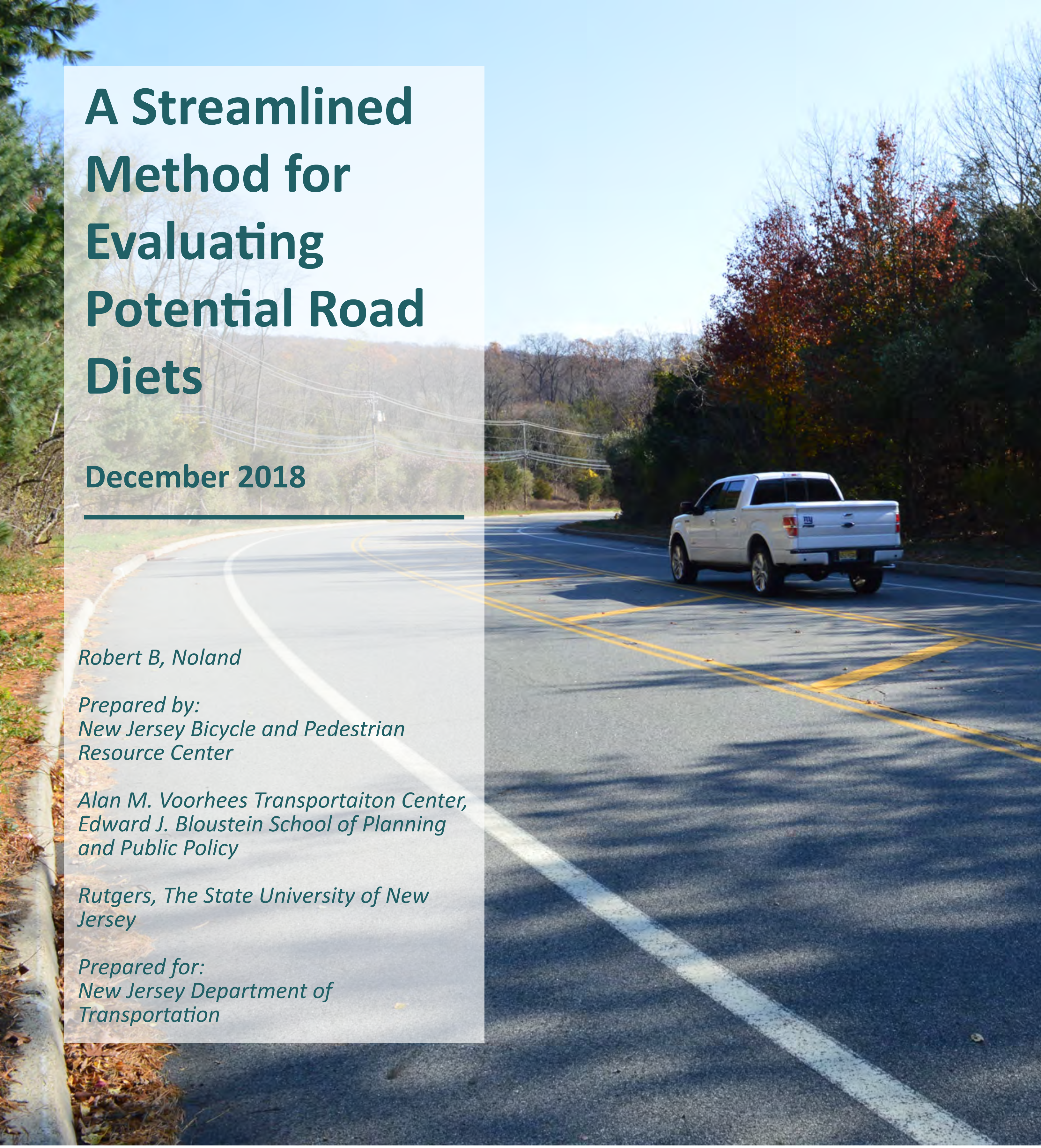

A Streamlined Method for Evaluating Potential Road Diets

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Introduction

Road diets typically involve the reduction of road space dedicated to motorized traffic. The typical example is reducing a four-lane road with no median separation to a three-lane road with the middle lane dedicated for left-turns and passing (e.g. see Figure 1). The justification for these road conversions is to improve the safety of the road and to make it more amenable to walking and cycling. The conversion frequently allows sufficient space to be dedicated to an on-street cycle lane or a shoulder with space for cycling.

While decisions to make these changes are usually triggered by a safety problem, it can often take years to actually implement the change, primarily due to the requirement that various traffic studies be conducted. A good example is the long delay in implementing a road diet on Livingston Ave. in New Brunswick, New Jersey. The project was announced in March 2014 (following three children being injured by a motorist). As of Dec 2018, the project has not been implemented and well over $500,000 has been spent on various engineering studies. While the final project will involve more detailed engineering and a new signal system, a simple restriping could have been implemented quickly and at a lower cost than the cost of the studies that have been conducted in the interim. In the meantime, the road remains unsafe for pedestrians and other users (an additional two children being injured in Oct 2016). As of this writing, the conversion and other work are due for completion in 2019.

So why does this take so long? One reason is that there is typically controversy over the consequences of reducing road capacity. The fear is that the loss of capacity will lead to congestion. This is certainly a possible outcome, but is dependent on the location of the road and the availability of other routes for vehicles. In most cases, there are various requirements to conduct a traffic study to evaluate the impact on congestion and consider ways to mitigate that congestion. However, if congestion is an outcome, it will typically slow down vehicle traffic, which has the benefit of improving safety for all modes. Many roads considered for road diets typically have speed limits that are not appropriate for the surrounding land uses or have a large number of drivers violating the posted speed limit. As such, the design changes to the road (via restriping) can reduce the speed of vehicles, and do so more effectively than increased police enforcement.

The main benefit of a road diet conversion is improved safety for all users. There is some research from the Federal Highway Administration (FHWA) that documents the potential reduction in crashes (Thomas, 2013); however, this is based on only six studies. The *Highway Safety Manual* (Transportation Research Board, 2010) specifies a crash reduction factor (CRF) associated with road diets, but is based on the same review and only reports one CRF from the FHWA study. Each specific treatment will likely have different effects that could be larger or smaller than the reductions reported elsewhere and are dependent on the characteristics of the road. Thus, the actual reductions, while likely, are largely unknown.

The reduction in traffic speeds and possible congestion effects are also difficult to forecast. Road diets, while reducing capacity, also channelize traffic flow by removing left-turning vehicles from the travel lane. This can actually increase the level of flow on some streets, depending on local circumstances, such as surrounding land uses. Most traffic simulation and estimation models do not necessarily consider these complexities and may be subject to uncertainty (which is not documented).

The objective of this project is to develop a simpler and faster evaluation approach for road diet conversions. The working assumption is that we do not know precisely what the safety benefits will be and traffic impacts also have a large amount of uncertainty. The methodology outlined below has very liberal assumptions on the amount of travel delay caused by a road diet with the objective of looking at worst case scenarios. With this assumption we ask the question: "What is the break-even point at which delay costs are equal to safety benefits?" That is, how large a crash reduction is needed to justify implementing the project?

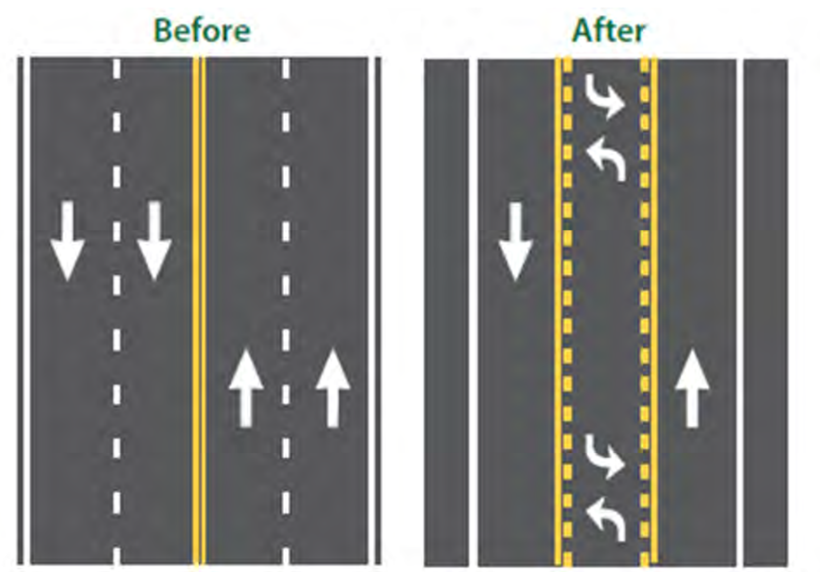

Figure 1. Typical road diet reconfiguration.

Source: https://safety.fhwa.dot.gov/road_diets/guidance/info_guide/ch1.cfm#s11

Methodology and Data

Using a simple cost-benefit analysis approach that relies on published USDOT guidance (US Department of Transportation, 2017), our method is based on a break-even analysis. That is, if we assume that congestion increases (expressed as the change in travel time), we ask the question: "How much benefit is needed from safety improvements to be equal to any increased travel time costs?" Our approach does not rely on detailed traffic impact studies, but uses existing traffic count data, or simple traffic counts at peak times as a baseline. We outline the data requirements, assumptions, and analysis approach below.

Data collected

Safety data was downloaded from NJVoyager[1] and either 3 or 5-year averages are used to establish a baseline. Numetric is also available for downloading NJ crash data.[2] Traffic count data was collected for 10 streets that are potential candidates for a road diet (based on a list provided by the New Jersey Safe Routes to School Resource Center). These street locations and the data collected for each are listed in Table 1. To collect the traffic count data, graduate student teams were dispatched and conducted 30 minute counts during the evening peak in the direction of peak traffic flow. These counts included the number of trucks and buses in the peak direction. Crash data is summed over a 3-year or 5-year period as indicated in Table 1.

Table 1. Candidate road diet streets

	Length of segment (miles)	Posted speed limit (mph)	30 min traffic count (cars/trucks/buses)	Crashes (No injury/any injury/killed)
Springfield Ave., Irvington Township, between Becker Terr. and Washington Ave.	1.2	25	329/1/6	399/100/0
JFK Boulevard, Jersey City, between Sip Ave. and Communipaw Ave.	1.0	25	497/17/9	380/115/1
JFK Boulevard, Bayonne, between 15th and 31st St.	1.0	25	139/3/6	157/43/0
Raritan Ave. (SR 27), Highland Park, between N. 8th Ave. and Columbia St.	0.5	40	320/8/0	27/18/1
SR 27, Elizabeth, NJ, between Westfield Ave. and Fairmount Ave.	0.5	25	423/3/7	201/68/0*
SR 27, Rahway, between West Lake Ave. and Linden Ave.	1.6	25	608/14/0	682/204/2*
South Livingston Ave., Livingston, NJ, between Mt. Pleasant Ave. and Civic Center Rd.	1.0	35	242/4/2	199/40/0
Avenue C, Bayonne, between 17th and 33rd Street	1.0	25	235/1/5	115/52/0*
Central Ave., East Orange City, between South Clinton St. and West Market St.	1.7	35	310/1/3	301/142/0
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	1.8	35	381/1/10	471/131/1

Note: * indicates 5-year total, all other crash statistics summed over 3-years. Injury includes "possible injury", "non-incapacitating", "incapacitating", and "unknown if injured"

Valuation of travel time

The official method for valuation of travel time is based on US median household income (US Department of Transportation, 2017). It is assumed that travel time is equivalent to one-half the median household income for personal travel. Business travel is estimated to be 100% of the US median household income. For this analysis, we have estimated travel time costs with both the US median household income and New Jersey median household income, which is substantially higher. USDOT

[1] https://www.njvoyager.org/App/

[2] https://njdhts.numetric.com/#/

guidance includes an escalation factor of 1.6% per year (US Department of Transportation, 2017). Values for 2010 and 2017 are shown in Table 2.

Table 2. Median household income used in valuation of travel time

	2010	2017
Median HH income, NJ	$71,637	$80,056
Median HH income, US	$53,046	$59,280

Source: US Census data, 2010

The household income values translate to value of time per hour, based on 2080 hours of work per year. These values for 2017 are shown in Table 3.

Table 3. Values of time per hour for personal and business travel

	Personal travel	Business travel
Hourly value of time, NJ	$19.24	$38.49
Hourly value of time, US	$14.25	$28.50

Valuation of Statistical Life

To estimate the value of a statistical life, US DOT sets an average value as well as a low and high estimate (US Department of Transportation, 2017). These are adjusted annual with a 1.07% escalator. These estimates are based on a comprehensive review of the literature conducted by US DOT and are recommended for use in cost-benefit analysis for federal projects.

Table 4. Value of a statistical life

	2012	2017
DOT value of life measure (low)	$5,200,000	$5,484,218
DOT value of life measure (average)	$9,100,000	$9,597,381
DOT value of life measure (high)	$12,900,000	$13,605,078

Source: US Department of Transportation (2017)

In order to account for non-fatal injury crashes, the Maximum Abbreviated Injury Scale (MAIS) is used (see Table 5). This links the severity of the injury to a fraction of the value of statistical life (VSL). This ranges from minor injuries to unsurvivable, i.e. fatal injuries (Harmon, Bahar, & Gross, 2018).

Table 5. Maximum Abbreviated Injury Scale (MAIS)

MAIS Level	Severity	Fraction of VSL
MAIS 1	Minor	0.003
MAIS 2	Moderate	0.047
MAIS 3	Serious	0.105
MAIS 4	Severe	0.266
MAIS 5	Critical	0.593
MAIS 6	Unsurvivable	1.000

New Jersey crash data is not recorded in a format compatible with the MAIS but instead uses an approximation of the KABCO scale. Police reports list injuries as "no injury", "possible injury", "non-capacitating", "incapacitating", and "killed", as well as "injured-severity unknown" and "unknown if injured". We match these up with the KABCO scale in Table 6 and show the conversion to the MAIS scale (Harmon et al., 2018). This allows us to use the distribution of different crash types and convert to the MAIS scale to estimate a value of statistical lives lost for each street segment analyzed.

Table 6. Conversion of KABCO and New Jersey scales to MAIS

		KABCO						
		O	C	B	A	K	U	Non-fatal
MAIS		No injury	Possible injury	Non-incapacitating	Incapacitating	Killed	Injured-severity unknown	Unknown if injured
0	No Injury	0.92534	0.23437	0.08347	0.03437	0	0.21538	0.43676
1	Minor	0.07257	0.68946	0.76843	0.55449	0	0.62728	0.41739
2	Moderate	0.00198	0.06391	0.10898	0.20908	0	0.104	0.08872
3	Serious	0.00008	0.01071	0.03191	0.14437	0	0.03858	0.04817
4	Severe	0	0.00142	0.0062	0.03986	0	0.00442	0.00617
5	Critical	0.00003	0.00013	0.00101	0.01783	0	0.01034	0.00279
6	Unsurvivable	0	0	0	0	1	0	0

No injury crashes also involve a property damage cost. We assume a 2010 value of $3682.00, escalated at 1.07% to a 2017 value of $3967.00 per crash (US Department of Transportation, 2014). Property damage costs are not applied to the valuations for injury crashes, as these are already factored into the MAIS.

Other assumptions and calculations

A recent report provides some guidelines on the costs of road diet conversions (Federal Highway Administration, 2016). A review of New Jersey bid sheets suggests that restriping costs no more than about $2500/mile. Therefore, assuming six stripes need to be removed and replaced by six stripes (see Figure 1. Typical road diet reconfiguration.), this would be $30,000/mile. Including bicycle lanes would cost more. Instead of this figure, we assume a low estimate of $100,000 based on (Federal Highway Administration, 2016), a medium level of $500,000 and a high estimate of $5,000,000. This in the spirit of assuming high costs as some projects may involve more than simple restriping.

Time valuations are adjusted assuming that vehicle occupancy is 1.2 people/vehicle and 25 per bus. We factor up our peak traffic counts (based on 30-minute peak hour counts) by 4.8 for the full peak period, and assume that the flow in the off-peak direction is the same. AM peak is assumed to be 0.75 of PM peak, and finally we multiply by an additional factor of 3 to account for all vehicles during the day (assuming 6 hours at ½ the volume). This is a very rough calculation with the objective of assuming as much traffic is affected as possible, leading to higher total time costs. From this, we calculate the total person-hours of travel time for the segment length.

To account for congestion, we assume that average speeds are reduced to 20 mph. Most of the streets that we analyze are posted at 25 mph, though some are higher, and for these we assume average time is reduced to 25 mph. Most of these roads have substantial speeding, and we do not assume any costs associated with decreasing the travel time of speeders. Our speed reductions may be an overestimate of actual speed reductions, especially if base speeds are lower to begin with (we did not measure speeds). The speed differential is used to estimate the time-value of the reduction in travel for each person-hour of travel on the road segment.

Finally, to calculate total net present value (NPV), we assume a 4.0% discount rate over 20 years.

Results

Our aim is to examine what the break-even net present value is between benefits and costs of a road diet conversion. Or put another way, what reduction in crashes justifies an increase in travel delay? Our analysis strategy involves testing a number of different scenarios, such that travel delay has large increases and evaluating what level of crash reduction leads to a zero net present value. This is done for all 10 streets. We use both NJ and US estimates of median household income for our travel time valuations; high, medium, and low estimates for the value of statistical life; and, three levels of construction costs. We analyze results with three different baseline assumptions. These are that off-peak traffic is also delayed, without any off-peak delay, and by assuming that the baseline safety record includes one additional fatality (among the 10 road segments analyzed, there was a total of 5 fatalities over three years).

The results are presented in tabular format for all these alternative scenarios. The values in the tables represent the level of crash reduction needed to justify the road diet. These values range from very low percent reductions (of less than 10%) to some requiring over 70% reduction in crashes. The average across all scenarios is 30% with a median break-even reduction of 24%. These results are shown in Table 7, Table 8, Table 9, Table 10, Table 11, and Table 12.

The break-even points can also be viewed graphically. To do this, we set fixed levels of crash reduction from 0% to 100% and estimated the net present value for each level. Results are plotted for Springfield Ave. (Irvington Township) and shown in Figure 2, Figure 3, Figure 4, and Figure 5. The breakeven point is when the line crosses the x-axis at which NPV = $0.00. The graphs show the variation between each scenario.

Another way to interpret this analysis is that for each 1% reduction in crashes, there is a reduction in the NPV. This is represented by the slopes of each line, which are determined by the VSL and baseline safety conditions; the constant of each line is determined by the travel time valuation and other assumptions. Table 13 shows the change in NPV for every one percent reduction in crashes for the Springfield Ave. case, based on the safety record of the street and assuming there is one additional fatality in the safety records (over a three year period). This largely demonstrates the trade-offs between travel time and safety. Put another way, is a decision maker willing to forgo $162,236 to reduce crashes by 1% assuming they have a low valuation of a statistical life? Or if they have a high valuation of a statistical life, and the street has a bad safety record, would they forgo $651,331?

Conclusions

The methodology presented here provides an approach to evaluating the costs and benefits of road diet implementations or any project that involves trade-offs between increased travel delay and reduced crashes. The underlying assumption is that we do not know how crashes are affected and we likewise are not certain of the traffic impacts. The approach allows for many different assumptions to be tested based on the preferences and prior beliefs of decision makers and the public that they represent. If a robust set of scenarios suggests that minor reductions in crashes achieve a net benefit, then the project will have a social benefit and is worth pursuing. The method allows decision makers to see the explicit trade-offs inherent between the costs of travel time increases and reductions in crashes.

In addition, this method can replace engineering and traffic impact analysis that can be costly and lead to delay in project implementation. For simple restriping projects, very little design work is needed in most cases. Streets can be restriped at minimal cost. If the project is found to be unsuccessful, for example, leading to major unanticipated traffic problems, it can be quickly reversed with another restriping. This can often cost less than any analysis that might suggest the project will not work. This is a form of "tactical urbanism"; that is, projects can be implemented quickly, their impacts evaluated, and reversed if unsuccessful. In addition, this allows the community to see the impact of the project, and whether it is positive or has negative consequences, adding extra evidence for any public engagement process.

This method can also be used as a tool to prioritize potential projects. Minimal data needs to be collected; safety data is readily available and traffic counts are also available for some streets, however, this approach does not require detailed counts. The examples shown here were based on 30-minute peak hour counts.

This methodology also has various limitations. These are mainly the omission of other difficult to quantify benefits of road diets, such as improved walkability, quality of life, development potential and both emissions and noise reductions. While a more detailed analysis could assess some of these benefits, our view is that analyzing safety benefits is sufficient. Most of the streets analyzed here have achievable breakeven points; when one considers that there are likely to be additional non-quantified benefits, it makes many of these road diets even more beneficial. The only additional negative impact might be the removal of some on-street parking, in particular if a bicycle lane is part of the project.

Table 7. Breakeven crash reduction, assuming NJ value of time and off-peak delay

	NJ value of time				
	High VSL $5,000,000 construction cost values/construction cost	Medium VSL $500,000 construction cost	Low VSL $100,000 construction cost	High VSL values $100,000 construction cost	Medium VSL values $100,000 construction cost
Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave.	43.2%	41.3%	63.2%	29.2%	39.7%
JFK Boulevard, Jersey City, between Sip Ave. and Communipaw Ave.	27.8%	29.4%	47.5%	20.5%	28.5%
JFK Boulevard, Bayonne, between 15th and 31st St	62.6%	48.0%	71.9%	32.6%	44.7%
Raritan Ave (SR 27), Highland Park, between N. 8th Ave and Columbia St.	28.3%	21.8%	35.0%	14.3%	20.2%
SR 27, Elizabeth, NJ, between Westfield Ave and Fairmount Ave	90.9%	71.3%	106.7%	48.8%	66.6%
SR 27, Rahway, between W Lake Ave and Linden Ave.	33.8%	38.4%	62.7%	27.1%	37.7%
South Livingston Ave, Livingston, NJ, between Mt. Pleasant Ave. and Civic Center Rd.	83.4%	68.2%	100.1%	47.7%	64.3%
Ave C, Bayonne, between 17th and 33rd St.	99.4%	84.5%	132.1%	57.5%	79.7%
Central Ave, East Orange City, between South Clinton St. and West Market St.	42.9%	45.3%	72.5%	31.9%	44.1%
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	41.5%	48.4%	78.5%	34.4%	47.6%

Table 8. Breakeven crash reduction, assuming US value of time and off-peak delay

	US value of time				
	High VSL $5,000,000 construction cost values/construction cost	Medium VSL $500,000 construction cost	Low VSL $100,000 construction cost	High VSL values $100,000 construction cost	Medium VSL values $100,000 construction cost
Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave.	35.7%	31.1%	46.9%	21.7%	29.5%
JFK Boulevard, Jersey City, between Sip Ave. and Communipaw Ave.	22.5%	22.0%	35.3%	15.3%	21.2%
JFK Boulevard, Bayonne, between 15th and 31st St	54.3%	36.6%	53.6%	24.3%	33.3%
Raritan Ave (SR 27), Highland Park, between N. 8th Ave and Columbia St.	24.7%	16.7%	26.1%	10.6%	15.0%
SR 27, Elizabeth, NJ, between Westfield Ave and Fairmount Ave	78.5%	54.3%	79.5%	36.4%	49.7%
SR 27, Rahway, between W Lake Ave and Linden Ave.	26.8%	28.7%	46.5%	20.1%	27.9%
South Livingston Ave, Livingston, NJ, between Mt. Pleasant Ave. and Civic Center Rd.	71.2%	51.8%	74.5%	35.5%	47.9%
Ave C, Bayonne, between 17th and 33rd St.	84.7%	64.1%	98.3%	42.8%	59.3%
Central Ave, East Orange City, between South Clinton St. and West Market St.	34.7%	34.0%	53.8%	23.7%	32.7%
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	32.6%	36.1%	58.2%	25.5%	35.3%

Table 9. Breakeven crash reduction, assuming NJ value of time and no off-peak delay

	NJ value of time				
	High VSL $5,000,000 construction cost values/construction cost	Medium VSL $500,000 construction cost	Low VSL $100,000 construction cost	High VSL values $100,000 construction cost	Medium VSL values $100,000 construction cost
Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave.	24.9%	16.4%	23.7%	10.9%	14.9%
JFK Boulevard, Jersey City, between Sip Ave. and Communipaw Ave.	14.9%	11.5%	17.7%	7.7%	10.6%
JFK Boulevard, Bayonne, between 15th and 31st St	42.4%	20.3%	27.4%	12.4%	17.0%
Raritan Ave (SR 27), Highland Park, between N. 8th Ave and Columbia St.	19.5%	9.3%	13.3%	5.4%	7.7%
SR 27, Elizabeth, NJ, between Westfield Ave and Fairmount Ave	60.6%	30.0%	40.5%	18.5%	25.3%
SR 27, Rahway, between W Lake Ave and Linden Ave.	16.8%	14.8%	23.3%	10.1%	14.0%
South Livingston Ave, Livingston, NJ, between Mt. Pleasant Ave. and Civic Center Rd.	53.7%	28.2%	37.8%	18.0%	24.3%
Ave C, Bayonne, between 17th and 33rd St.	63.6%	34.9%	49.9%	21.7%	30.1%
Central Ave, East Orange City, between South Clinton St. and West Market St.	22.9%	17.7%	27.0%	11.9%	16.4%
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	19.9%	18.5%	29.1%	12.8%	17.7%

Table 10. Breakeven crash reduction, assuming US value of time and no off-peak delay

	US value of time				
	High VSL $5,000,000 construction cost values/construction cost	Medium VSL $500,000 construction cost	Low VSL $100,000 construction cost	High VSL values $100,000 construction cost	Medium VSL values $100,000 construction cost
Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave.	22.1%	12.7%	17.7%	8.2%	11.1%
JFK Boulevard, Jersey City, between Sip Ave. and Communipaw Ave.	12.9%	8.8%	13.2%	5.7%	7.9%
JFK Boulevard, Bayonne, between 15th and 31st St	39.3%	16.1%	20.6%	9.3%	12.8%
Raritan Ave (SR 27), Highland Park, between N. 8th Ave and Columbia St.	18.2%	7.4%	10.1%	4.1%	5.8%
SR 27, Elizabeth, NJ, between Westfield Ave and Fairmount Ave	56.0%	23.7%	30.5%	13.9%	19.0%
SR 27, Rahway, between W Lake Ave and Linden Ave.	14.2%	11.2%	17.3%	7.5%	10.4%
South Livingston Ave, Livingston, NJ, between Mt. Pleasant Ave. and Civic Center Rd.	49.2%	22.2%	28.4%	13.5%	18.3%
Ave C, Bayonne, between 17th and 33rd St.	58.2%	27.4%	37.5%	16.3%	22.6%
Central Ave, East Orange City, between South Clinton St. and West Market St.	19.9%	13.5%	20.2%	8.9%	12.3%
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	16.6%	13.9%	21.7%	9.5%	13.1%

Table 11. Breakeven crash reduction, assuming NJ value of time and no off-peak delay and one additional baseline fatality

	NJ value of time				
	High VSL $5,000,000 construction cost values/construction cost	Medium VSL $500,000 construction cost	Low VSL $100,000 construction cost	High VSL values $100,000 construction cost	Medium VSL values $100,000 construction cost
Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave.	23.3%	22.7%	36.2%	15.7%	21.8%
JFK Boulevard, Jersey City, between Sip Ave. and Communipaw Ave.	19.2%	20.5%	33.6%	14.2%	19.9%
JFK Boulevard, Bayonne, between 15th and 31st St	22.1%	17.3%	27.3%	11.5%	16.1%
Raritan Ave (SR 27), Highland Park, between N. 8th Ave and Columbia St.	15.2%	11.7%	18.9%	7.7%	10.8%
SR 27, Elizabeth, NJ, between Westfield Ave and Fairmount Ave	35.7%	28.6%	45.1%	19.1%	26.7%
SR 27, Rahway, between W Lake Ave and Linden Ave.	27.1%	30.9%	51.0%	21.7%	30.3%
South Livingston Ave, Livingston, NJ, between Mt. Pleasant Ave. and Civic Center Rd.	26.2%	22.2%	35.1%	15.0%	20.9%
Ave C, Bayonne, between 17th and 33rd St.	39.1%	33.7%	54.4%	22.6%	31.8%
Central Ave, East Orange City, between South Clinton St. and West Market St.	25.6%	27.4%	44.8%	19.1%	26.6%
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	28.9%	34.0%	56.1%	24.0%	33.4%

Table 12. Breakeven crash reduction, assuming US value of time and no off-peak delay and one additional baseline fatality

	US value of time				
	High VSL $5,000,000 construction cost values/construction cost	Medium VSL $500,000 construction cost	Low VSL $100,000 construction cost	High VSL values $100,000 construction cost	Medium VSL values $100,000 construction cost
Springfield Ave, Irvington Township, between Becker Terr. And Washington Ave.	19.2%	17.1%	26.9%	11.7%	16.2%
JFK Boulevard, Jersey City, between Sip Ave. and Communipaw Ave.	15.6%	15.4%	25.0%	10.6%	14.8%
JFK Boulevard, Bayonne, between 15th and 31st St	19.1%	13.2%	20.4%	8.6%	12.0%
Raritan Ave (SR 27), Highland Park, between N. 8th Ave and Columbia St.	13.3%	8.9%	14.1%	5.7%	8.1%
SR 27, Elizabeth, NJ, between Westfield Ave and Fairmount Ave	30.8%	21.8%	33.6%	14.3%	19.9%
SR 27, Rahway, between W Lake Ave and Linden Ave.	21.5%	23.1%	37.8%	16.1%	22.5%
South Livingston Ave, Livingston, NJ, between Mt. Pleasant Ave. and Civic Center Rd.	22.3%	16.8%	26.1%	11.1%	15.5%
Ave C, Bayonne, between 17th and 33rd St.	33.3%	25.6%	40.5%	16.8%	23.7%
Central Ave, East Orange City, between South Clinton St. and West Market St.	20.7%	20.5%	33.3%	14.2%	19.8%
Morris Ave., Union, NJ, between Milburn Ave. and Liberty Ave.	22.7%	25.3%	41.6%	17.8%	24.8%

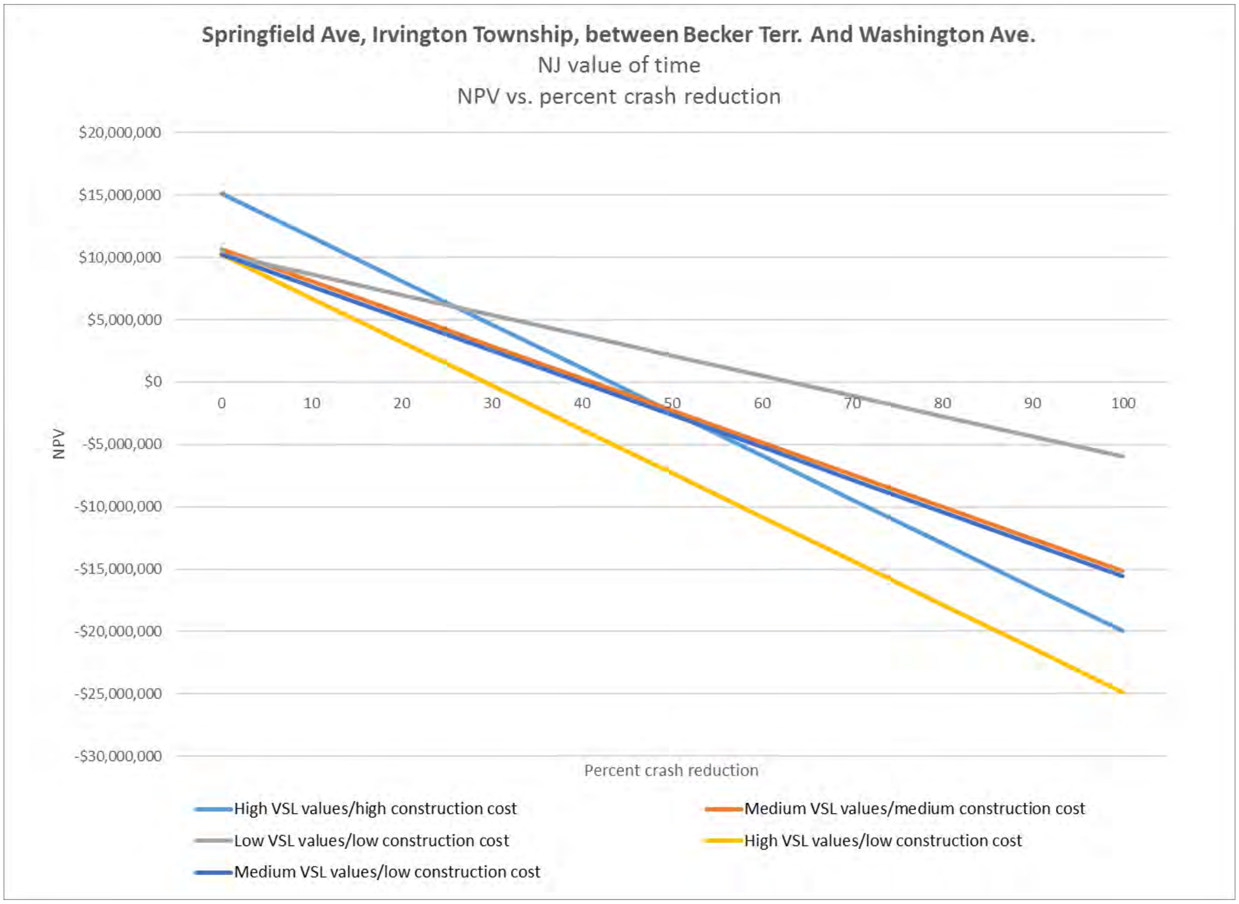

Figure 2. NPV vs. crash reduction, showing breakeven point

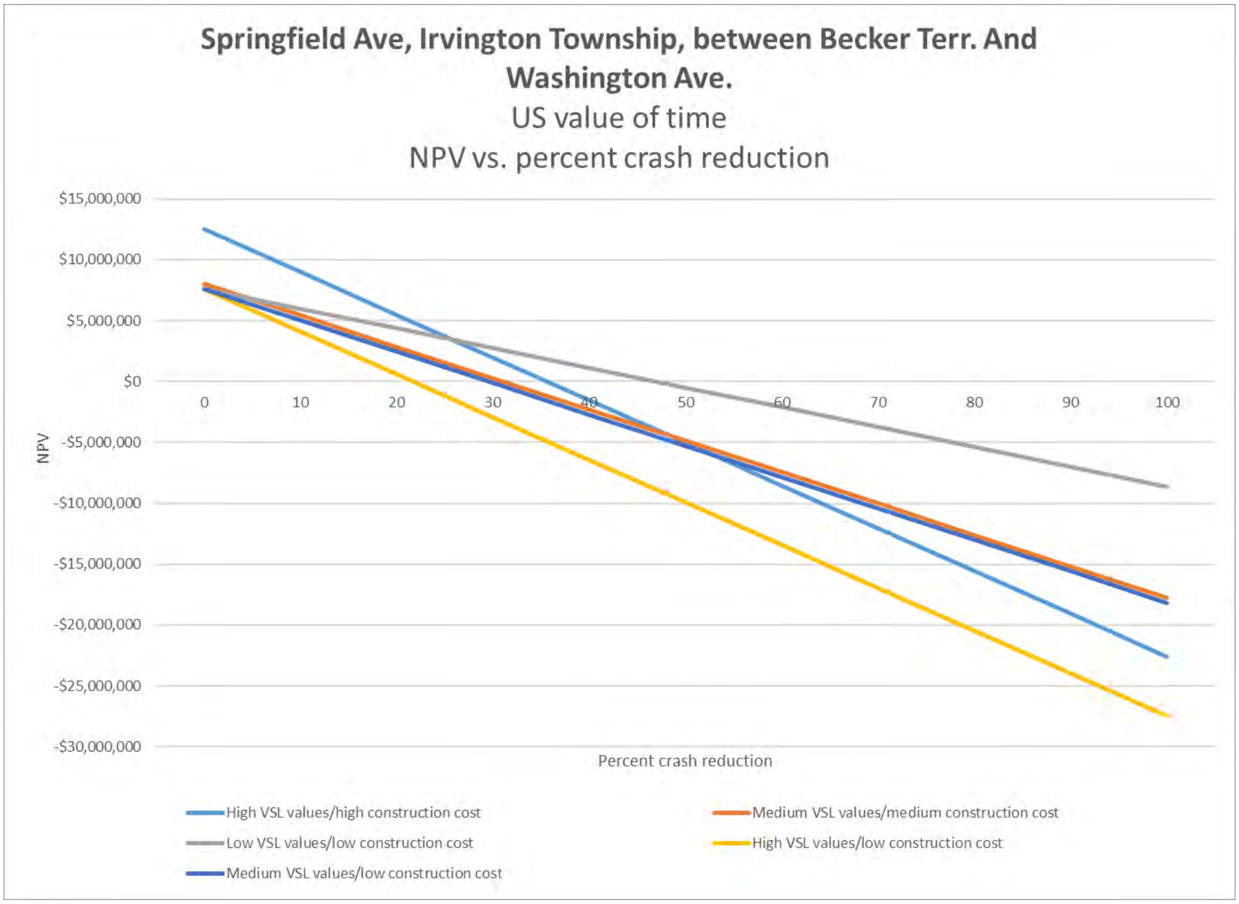

Figure 3. NPV vs. crash reduction, showing breakeven point

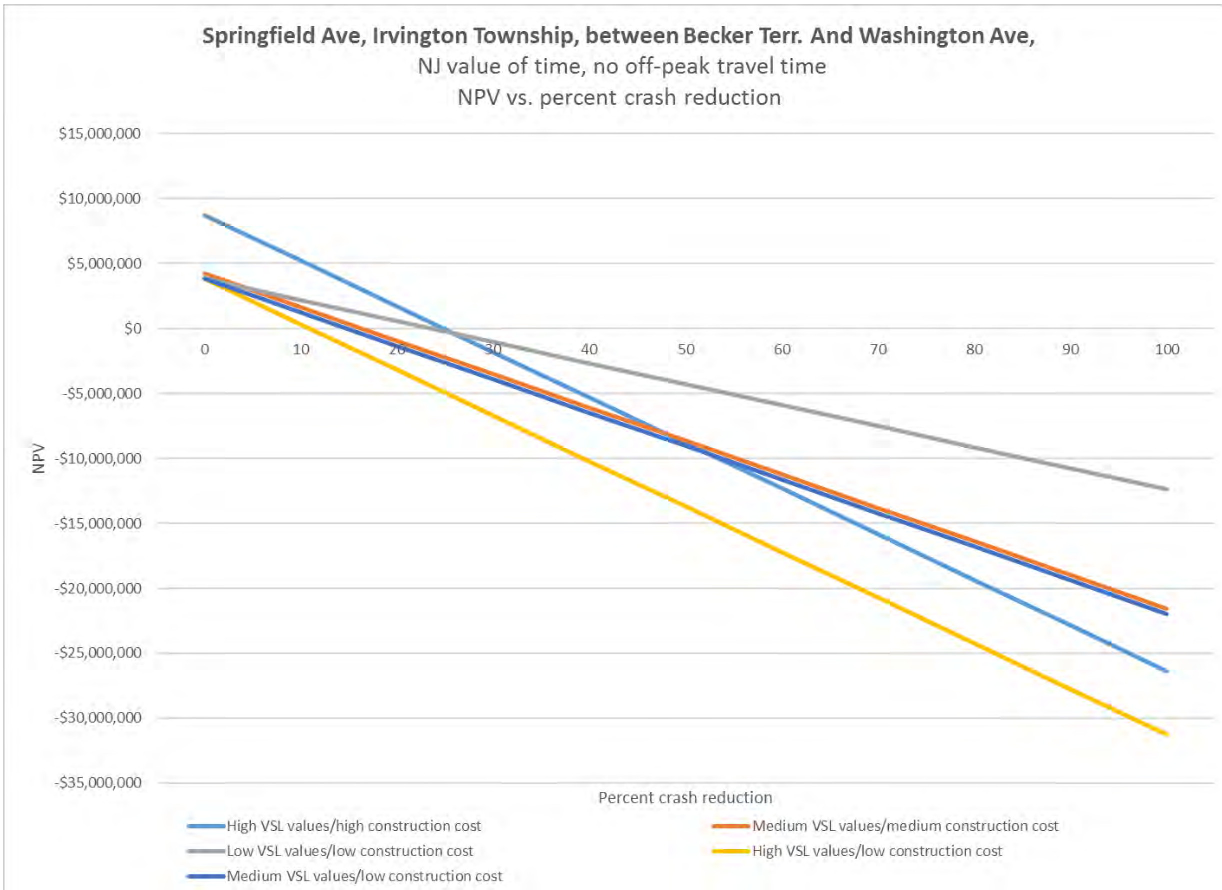

Figure 4. NPV vs. crash reduction, showing breakeven point

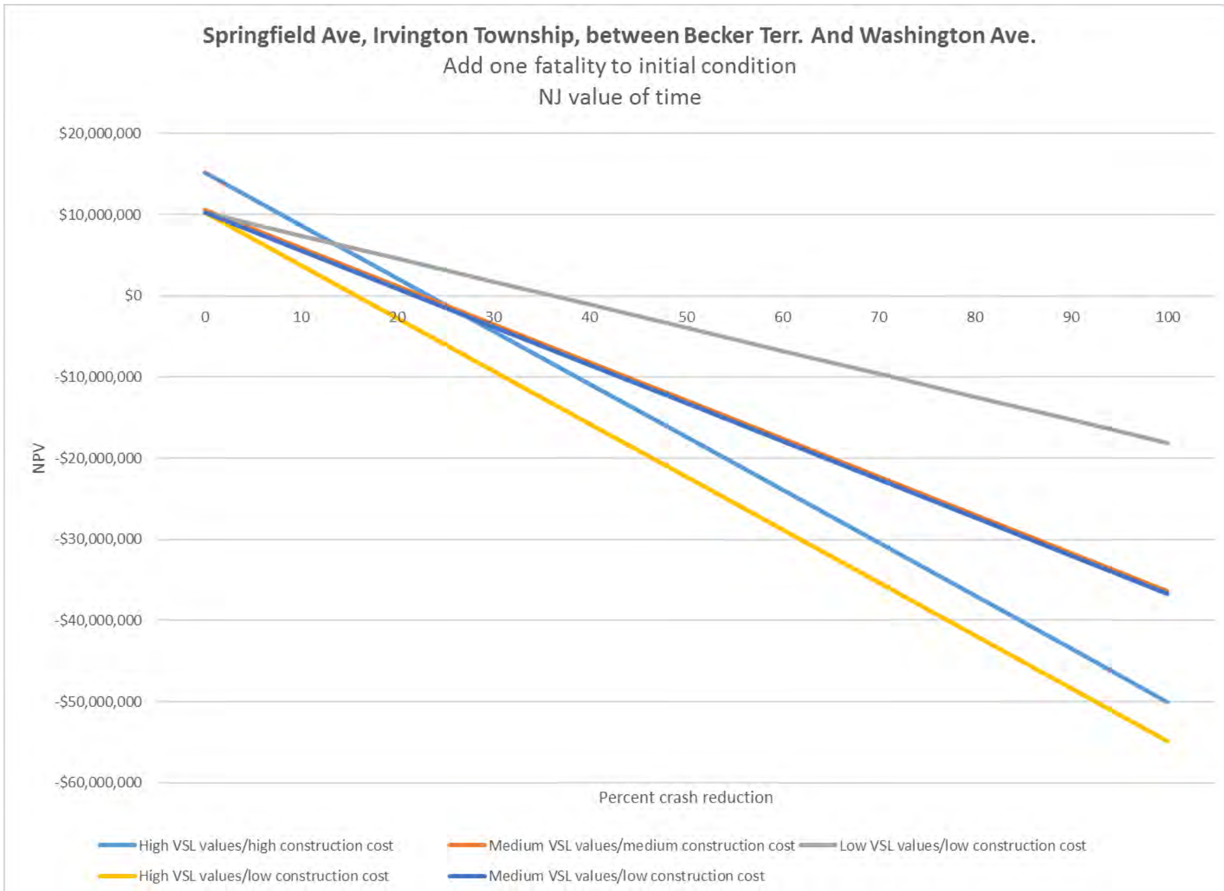

Figure 5. NPV vs. crash reduction, showing breakeven point

Table 13. Reduction in NPV for a 1% reduction in total crashes, Springfield Ave.

	High VSL	Medium VSL	Low VSL
Based on data collected	-$350,920	-$257,803	-$162,236
Add one fatality to initial conditions	-$651,331	-$469,721	-$283,332

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