

MEMORANDUM

TO: Councilmember Pierluigi Oliverio
FROM: Dev Davis, Misa Fujisaki, Miho Tanaka, Lucy Xiao¹
SUBJECT: **Analysis and Recommendations for Lincoln Ave Road Diet**
DATE: JUNE 12, 2015

Executive Summary

Over the past 6 weeks, our team of four Stanford University Public Policy graduate students conducted a social cost-benefit analysis of the Lincoln Avenue “road diet” initiative to provide the City of San Jose with a comprehensive overview of the social costs and benefits associated with this road diet.

Using data provided by the City of San Jose, we first conducted a rigorous statistical analysis of pre- and post-diet traffic counts and speeds, historical collision data for Lincoln Avenue, Lincoln Avenue driving times, and bicyclist and pedestrian counts. We confirmed significant traffic count and speed reductions on Lincoln Avenue during the road diet, although the data indicate that these effects were smaller than indicated in the city’s official report. We also found a positive upward trend in the number of bicyclists and pedestrians on Lincoln Avenue after the diet. However, these findings were not statistically significant, likely due to the small number of observations. For Lincoln Avenue driving times, results were mixed, with a decrease in average driving time during the middle of the day and an increase in average driving time during the evening rush.

We then combined these outcomes with results from existing academic literature to conduct a social cost-benefit analysis of the road diet. Given the currently available data, we find the overall net effect of the road diet to be inconclusive. The benefits of the road diet may or may not outweigh the costs depending on three main factors: (1) the actual reduction in collisions; (2) the road diet’s impact on livability for area residents; and (3) the road diet’s impact on sales for Lincoln Avenue businesses.

Recommendations

Based on these results, we recommend that the City of San Jose:

- Clarify and prioritize the goals of the road diet to better gauge whether the road diet successfully achieves its policy objectives.
- Determine the road diet’s impact on Lincoln Avenue businesses by gathering and analyzing pre- and post-diet data on business sales receipts.
- Survey area residents to gauge perceptions of the road diet’s impact on livability.
- Gather more pedestrian and bicycle traffic count observations over a longer time period to determine if the post-diet increases are statistically significant.

¹ We are graduate students in the Public Policy program at Stanford University. This information was originally prepared for the Stanford University graduate-level course, Public Policy 301B *Economic Policy Analysis*, held in Spring 2015.

Our Data

The City of San Jose provided data collected before and after implementation of the Lincoln Avenue road diet:

- **Traffic counts and speed:** This data was collected from traffic counter tubes installed in 45 locations on Lincoln Avenue and nearby roads. We were able to match two days of pre-diet and two days of post-diet data for 41 locations. The traffic count data contained 3,936 observations, and the average speed data contained 3,622 observations.²
- **Collision data:** We used historical collision data from December 2012 through December 2014. Post-diet collision data for Lincoln Avenue between Minnesota and Coe Avenues was not available at the time of our request.
- **Lincoln Avenue driving times:** City staff conducted a study of driving times on Lincoln between San Carlos and Curtner on Tuesday - Thursday, February 3-5, 2015, and Wednesday, April 8, 2015. Driving times were measured multiple times during morning rush, midday, and evening rush hours in both northbound and southbound directions. Since only one day of post-diet data on driving times was available, we compared it with the pre-diet studies conducted on the same day of the week (Wednesday, February 4), for a total of 72 observations. Number of stops and total delay time were also measured.
- **Bicyclist and pedestrian counts:** City staff counted the number of bicyclists and pedestrians observed at seven intersections on Lincoln Avenue between Coe and Curtner on February 3, 2015, and April 9, 2015. Data was collected for two hours during both morning and evening rush hour.

Our Methods

For each dataset, we employed the most rigorous statistical analysis methods available for the number of data observations:

- **Traffic counts and average speed:** We conducted a difference-in-differences regression analysis to determine the road diet's impact on traffic counts and average speed on Lincoln Avenue and surrounding residential roads.³ This method allowed us to control for certain confounding factors present in the data, including unusually low traffic counts in the post-diet data, likely due to Easter vacation for several nearby Catholic schools.

² 314 observations had zero vehicles, resulting in fewer traffic speed observations.

³ We used the following equation for our difference-in-differences regression:

$Y = \beta L + \theta R + \rho D + \alpha(L * D) + \tau(R * D) + \gamma T + \varepsilon$, where L = average traffic counts on Lincoln before the road diet; R = average traffic counts on residential streets before the road diet; D = average traffic counts during the road diet on all streets; and T = controls for time fixed effects. The same controls were used for our analysis of the road diet's impact on average traffic speeds.

As part of our analysis, we divided the traffic counter locations into three categories: “Lincoln Avenue,” “residential,” and “other.” Six of the 41 locations in our dataset were on Lincoln Avenue. Out of the remaining locations, we deemed 26 to be on primarily residential streets.⁴ The remaining nine locations were coded as “other” because the roads have four lanes of traffic and a speed limit above 25 mph, are primarily flanked by businesses, or, in the case of Almaden Road, contain residences on only one side of the street. A map of all 41 locations can be found in Appendix I.

- **Collision data:** Because post-diet data was unavailable, we were unable to conduct a statistical analysis for this measure. Instead, we estimated the road diet’s impact on Lincoln Avenue collisions based on the results of previous academic studies on road diets in locations with similar characteristics.
- **Lincoln Avenue driving times:** We conducted statistical t-tests for all observations and then separately for morning, midday and evening data points. The objective of these tests was to determine the road diet’s impact on average driving times on Lincoln Avenue for different times of the day.
- **Bicyclist and pedestrian counts:** We also conducted statistical t-tests separately for bicyclists and pedestrians. We were not able to conduct separate tests for the morning and evening rush hours due to the limited number of observations. The objective of this analysis was to determine the road diet’s impact on non-vehicular Lincoln Avenue traffic.

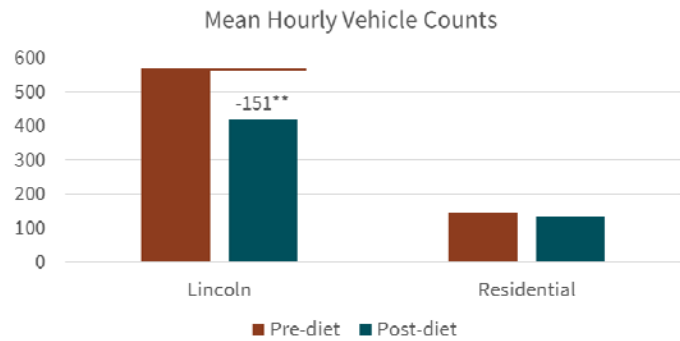
The ultimate goal of our project was to conduct a social cost-benefit analysis of the road diet. The findings from the data and methods described above informed our cost and benefit calculations. In addition, we used information from respected academic literature to supplement the data we received from the City of San Jose. Further details on how each measure was calculated are provided in the cost-benefit analysis section of this memo.

⁴ “Other” streets: Almaden Road, Bird Avenue (north of Coe only), Curtner Avenue (2 locations), Meridian Avenue, Minnesota Avenue (2 locations), Parkmoor Avenue, and Willow Street (between Lincoln and Bird Avenues).

Our Findings

Traffic Counts⁵

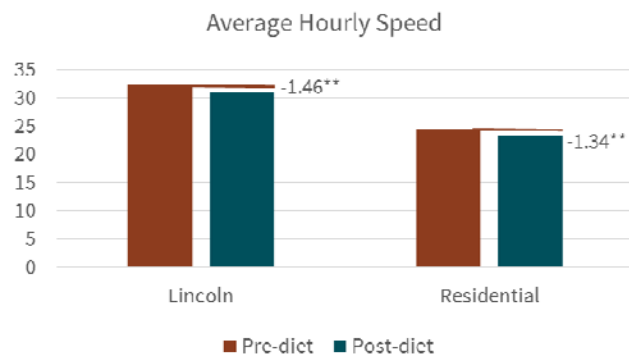
Before the road diet, an average of 568 vehicles traveled along Lincoln each hour. The regression results showed a statistically significant decrease of 151 vehicles per hour on Lincoln during the road diet.⁶ This represents a roughly 27% average decrease in traffic.



Residential streets saw an average of roughly 143 vehicles per hour before the road diet. On average, the road diet had no significant impact on traffic counts for residential streets. However, when we disaggregated these effects by street, we found that 10 streets experienced a statistically significant decrease in hourly vehicle counts, while four streets saw a statistically significant increase following implementation of the road diet.⁷ The remaining 12 residential streets experienced no statistically significant change in hourly vehicle counts.

Traffic Speed⁸

The average hourly vehicle speed on Lincoln Avenue before the road diet was 32.4 miles per hour (mph). Post-diet, the average speed dropped by nearly 1.5 mph.⁹



Average hourly speed was about 24.6 mph on residential streets before the road diet. Following implementation of the diet, average speed on these streets dropped by roughly 1.3 mph.¹⁰ As with the traffic count analysis, we disaggregated these effects to determine the road diet's impact on individual residential streets. Only one street saw no change in average speed, while 14 streets experienced a decrease in average speed and 11 streets saw an increase in average speed.¹¹

⁵ The pre-diet average hourly vehicle count for "other" streets was about 612. This group of streets formed the reference group for our difference-in-differences regression analysis. Therefore, we are unable to isolate the effects of the road diet on these streets.

⁶ **Significant at the .01 level.

⁷ Decreased traffic: California Ave, Curtiss Ave, El Abra Way, Garfield Ave, Iris Ct, Kottenburg Ave, Lester Ave, Michigan Ave, Newport Ave, and Settle Ave. Increased traffic: Bird Ave on the 1000 block, Bird Ave on the 1200 block, Coe Ave, and Hicks Ave.

⁸ Average hourly vehicle speed on "other" streets was 32.4 mph before the road diet. Similar to the traffic counts analysis, we are unable to isolate the effects of the road diet on this reference group.

⁹ **Significant at the .01 level.

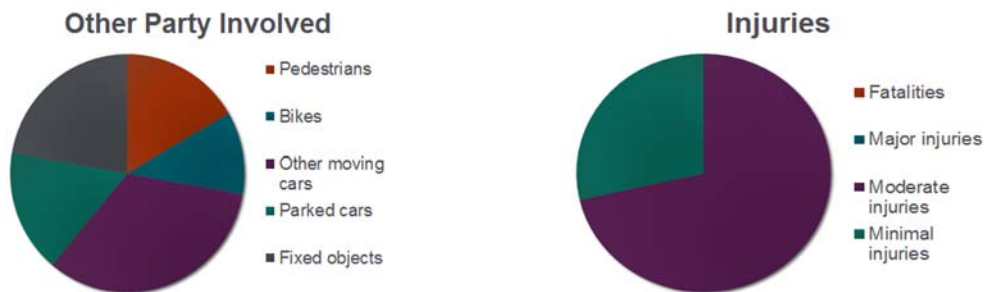
¹⁰ **Significant at the .01 level.

¹¹ Decreased speeds: Blewett Ave, California Ave, Curtiss Ave, El Abra Way, Garfield Ave, Glen Eyrie Ave, Iris Ct, Kottenburg Ave, Lester Ave, Michigan Ave, Newport Ave, Paula St, Settle Ave, and Willow St

Collisions on Lincoln Avenue

An average of nine accidents were reported annually on Lincoln Avenue. For each accident, the collision reports identify the other party involved. Each year, an average of 1.5 collisions involved pedestrians and one collision involved a bicyclist. The remaining collisions involved other moving vehicles, parked cars and fixed objects.

The collision reports also indicate whether each accident resulted in a fatality or one of three types of injuries - “major”, “moderate”, or “minimal”. Out of the nine average annual accidents, there were no fatalities or “major” injuries, 2.5 “moderate” injuries, and one “minimal” injury. The majority of the collisions resulting in injuries involved pedestrians and bicyclists.

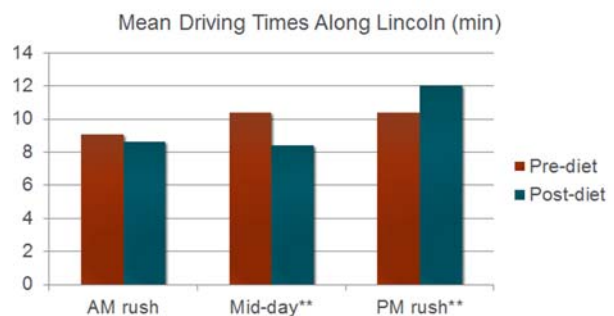


There are a number of limitations regarding the collision data. First, due to the small number of reported collisions and because we only examined two years of collision reports, this data exhibits high variance. This means the data could be skewed if there was an unusually low or high number of accidents in one or both years. Second, the injury severity categories are not rigidly defined, which could result in inconsistent reporting. Finally, it is possible that collisions were underreported since less serious collisions may have been handled privately.

Driving Times on Lincoln Avenue

The data show no statistically significant change in driving times during morning rush hours.

Average travel time dropped during the middle of the day, from an average of 10 minutes and 23 seconds to 8 minutes and 24 seconds. This reflects the fewer number of cars on the road, and echoes anecdotal feedback from Lincoln Avenue businesses.



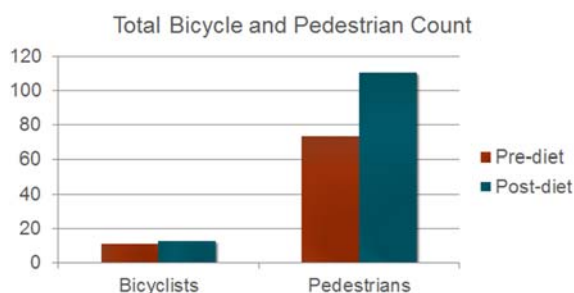
Average travel time increased during evening rush hours, from an average of 10 minutes and 24 seconds to 12 minutes and 2 seconds. There was also a significant increase in the number of

on the 1100 block. Increased speeds: Bird Ave on the 1000 block, Bird Ave on the 1200 block, Camino Ramon, Coe Ave, Hicks Ave on the 1400 block, Hicks Ave on the 1900 block, Malone Rd, Newport Ave, Pine Ave on the 1100 block, and Pine Ave on the 900 block.

stops experienced by the driving testers during this time, from an average of 6.5 stops to 8.33 stops.

Bicyclists and Pedestrians on Lincoln Avenue

The total number of bicyclists and pedestrians increased after the road diet. The average number of bicyclists per hour increased from 10.9 to 12.3, representing a 13% increase. The number of pedestrians also increased, from 73.5 to 110.5, a 50% increase.



These figures demonstrate a positive upward trend in the number of bicyclists and pedestrians on Lincoln Avenue. However, these results were not statistically significant, likely due to the limited number of observations in the dataset. Additional data collection would allow for a more robust test of statistical significance.

Cost-Benefit Analysis of Road Diet

Summary of Cost-Benefit Analysis

Summary of Lincoln Avenue Road Diet Costs and Benefits	
Benefits	Costs
Reduced collisions →\$38,816 - \$304,928	Restriping the roads →\$20,000
Livability →Net positive?	Increased travel time →\$46,140
Residential property values (neutral) Effects on businesses (unsure)	

We chose these measures based on three categories: (1) goals for the Lincoln Avenue road diet as enumerated by the City of San Jose; (2) existing academic literature; and (3) availability of data.

Our study found the overall impact of the road diet to be inconclusive based on currently available data. The total costs from restriping the road and increased travel time on Lincoln Avenue add up to \$66,140. The benefits of the road diet may or may not outweigh the costs depending on several factors: (1) the actual reductions in collisions; (2) changes in livability; and (3) the impact on sales for Lincoln Avenue businesses. The costs and benefits are broken down and described in greater detail below.

Costs Breakdown

We identified three main costs associated with the road diet: (1) opportunity costs resulting from increased driving times along Lincoln Avenue; (2) road restriping costs; and (3) a potential decrease in surrounding residential home values if the road diet rerouted traffic onto residential streets.

Increased travel time

The biggest cost of the road diet is increased travel time for drivers. We estimated this cost to be roughly \$46,140 via the following formula: value of travel time * increased travel time * occupancy per vehicle * 260 days.¹² A detailed breakdown of how we quantified this cost can be found in Appendix II.

Restriping the road

Implementing the road diet required grinding and striping the current road for a one-time cost of \$20,000.

Decline in residential property values

The average traffic volume on residential streets was unaffected by the road diet, and average speeds on residential streets declined slightly. For these reasons, the road diet is unlikely to cause a decline in residential property values. However, other livability issues related to the road diet may affect property values. These are discussed below.

Benefits Breakdown

We identified three main benefits associated with the road diet: (1) reduced collisions; (2) increased livability; and (3) increased sales for businesses on Lincoln Avenue.

Reduced collisions

Improved traffic safety as measured by a reduction in collisions is one of the road diet's primary goals. Because post-diet collision data was not available, we estimated the impact of the road diet on Lincoln Avenue collisions using results from past academic studies on road diets. We estimate that the road diet could result in anywhere between \$38,816 and \$304,928 in saved costs from reduced collisions. A detailed breakdown of how we quantified this benefit can be found in Appendix III.

Livability

Based on past road diet case studies, the Lincoln Avenue road diet has likely had a net positive effect on livability. However, we recommend that San Jose conduct a survey to more accurately gauge local perceptions of the road diet.

Livability in this context is not rigidly defined, but generally refers to residents' views on the overall neighborhood traffic environment, comfort and safety for pedestrians and bicyclists, and the overall character of the street.¹³ Case studies of six sites in the US, Canada and New Zealand revealed that residents generally felt that road diets contributed to more positive

¹² This formula is based on calculations found in: City of New Brunswick, New Jersey. (2014). *Costs and Benefits of a Road Diet for Livingston Avenue in New Brunswick, New Jersey*. Retrieved from: <http://thecityofnewbrunswick.org/planninganddevelopment/wp-content/uploads/sites/8/2014/04/Livingston-Ave-Road-Diet-Web.pdf>.

¹³ Long-term livability conditions will affect residential property values, so care must be taken not to double count these factors in the long term. However, survey data can provide an early indication of how livability is affected by this road diet.

livability conditions. There were some complaints about slower traffic, but most respondents liked that the road diet made the streets feel calmer and safer. These perspectives were gathered from online and door-to-door surveys.¹⁴

Increased business sales

As a stated reason for the road diet, the impact on Lincoln Avenue businesses must be considered when analyzing the costs and benefits of the initiative. Unfortunately, we were unable to gather data on business sales receipts before and after the road diet.

Case studies from previous road diets, including one implemented in Washington State, showed an increase in business sales receipts compared to similar streets in the city over the same time period. However, due to the context-specific nature of business sales, we could not extrapolate any meaningful conclusions based on only a few case studies. We therefore recommend that the City of San Jose collect and analyze data on business sales receipts for the months of March through May pre- and post-diet before deciding whether to make the new road configuration permanent.

Study Limitations

Our study contains a number of limitations, mainly due to the categories and length of time covered by the available data.

In terms of coverage, we were unable to obtain the following information: (1) post-diet collision data; (2) survey data to determine the road diet's impact on livability in Willow Glen; and (3) business sales receipts to assess the road diet's impact on local businesses. We believe this data to be critical for conducting a comprehensive and accurate cost-benefit analysis of the Lincoln Avenue road diet.

At the same time, the data that we were able to obtain is limited in its time coverage. We only have two days of pre- and post-diet observations for traffic counts and speeds; one day of pre- and post-diet observations for Lincoln Avenue driving times and bicyclist and pedestrian counts; and two years of historical data for Lincoln Avenue collisions. Therefore, although our econometric methods were rigorous, and in some cases were able to address certain data limitations, the small sample size in our datasets may nonetheless have skewed our results.

Comparison with the Official Road Diet Report

Our study contains both similarities and differences with the official Lincoln Avenue Road Diet Trial Data Collection Report published by the City of San Jose's Department of Transportation on June 1, 2015.¹⁵

¹⁴ Jennifer, R. *Past Presidents' Award for Merit in Transportation Engineering: Road Diet Handbook*. ITE Journal, November 2007, 26-41. Retrieved from: http://contextsensitivesolutions.org/content/case_studies/skycrest_traffic_calming_projec_161/resources/Past_Presidents_Award_for_Merit/.

In terms of similarities, both our study and the official report examine a number of the same categories, including traffic counts and speeds, bicyclist and pedestrian counts, and Lincoln Avenue travel times. In addition, both reports found similar broad implications regarding some effects of the road diet, including a reduction in traffic counts on Lincoln Avenue following the road diet.

However, there are three main differences between our analysis and the analysis conducted for the official report: (1) methods; (2) objectives; and (3) level of comprehensiveness.

- **Methods:** The official report conducted simple comparisons of average pre- and post-diet observations in each category, whereas our report employed more rigorous econometric techniques that resulted in more accurate estimates of the road diet's impact. For example, because the official analysis did not take into account confounding effects from the local Catholic schools' Easter vacation, the official report overstates the road diet's impact on traffic counts.
- **Objectives:** Although both reports were intended to evaluate the impact of the Lincoln Avenue road diet trial, the official report's main purpose was to provide the results of data collected during the trial period. The ultimate goal of our study, on the other hand, is to provide the City of San Jose with a broader analysis of the social costs and benefits resulting from the road diet.
- **Comprehensiveness:** In line with our objective of providing the City of San Jose with an analysis that is as comprehensive as possible, we supplemented data provided by the city with findings from existing academic literature. As a result, we integrated additional variables including livability, impact on residential home values, and impact on business sales receipts into the framework of our cost-benefit analysis.

Conclusion and Recommendations

To provide the City of San Jose with a comprehensive overview of the social costs and benefits associated with the Lincoln Avenue road diet, we first conducted a rigorous statistical analysis of data gathered through the city's observational studies. This includes data on pre- and post-diet traffic counts and speeds, historical collision data for Lincoln Avenue, Lincoln Avenue driving times, and bicyclist and pedestrian counts. We confirmed significant traffic count and speed reductions on Lincoln Avenue during the road diet, although the data suggest that the official report overstated these effects. We also found a positive upward trend in the number of bicyclists and pedestrians on Lincoln Avenue after the diet, although the small sample size likely contributed to a statistically insignificant finding. For Lincoln Avenue driving times, results were mixed, with a decrease in average driving time during the middle of the day and an increase in average driving time during the evening rush.

¹⁵ City of San Jose. Department of Transportation. (2015). *Lincoln Avenue Road Diet Trial Data Collection Report*. Retrieved from: http://willowglenroaddiet.com/pdf/DOT_Final_Lincoln%20Road%20Diet%20Report.pdf.

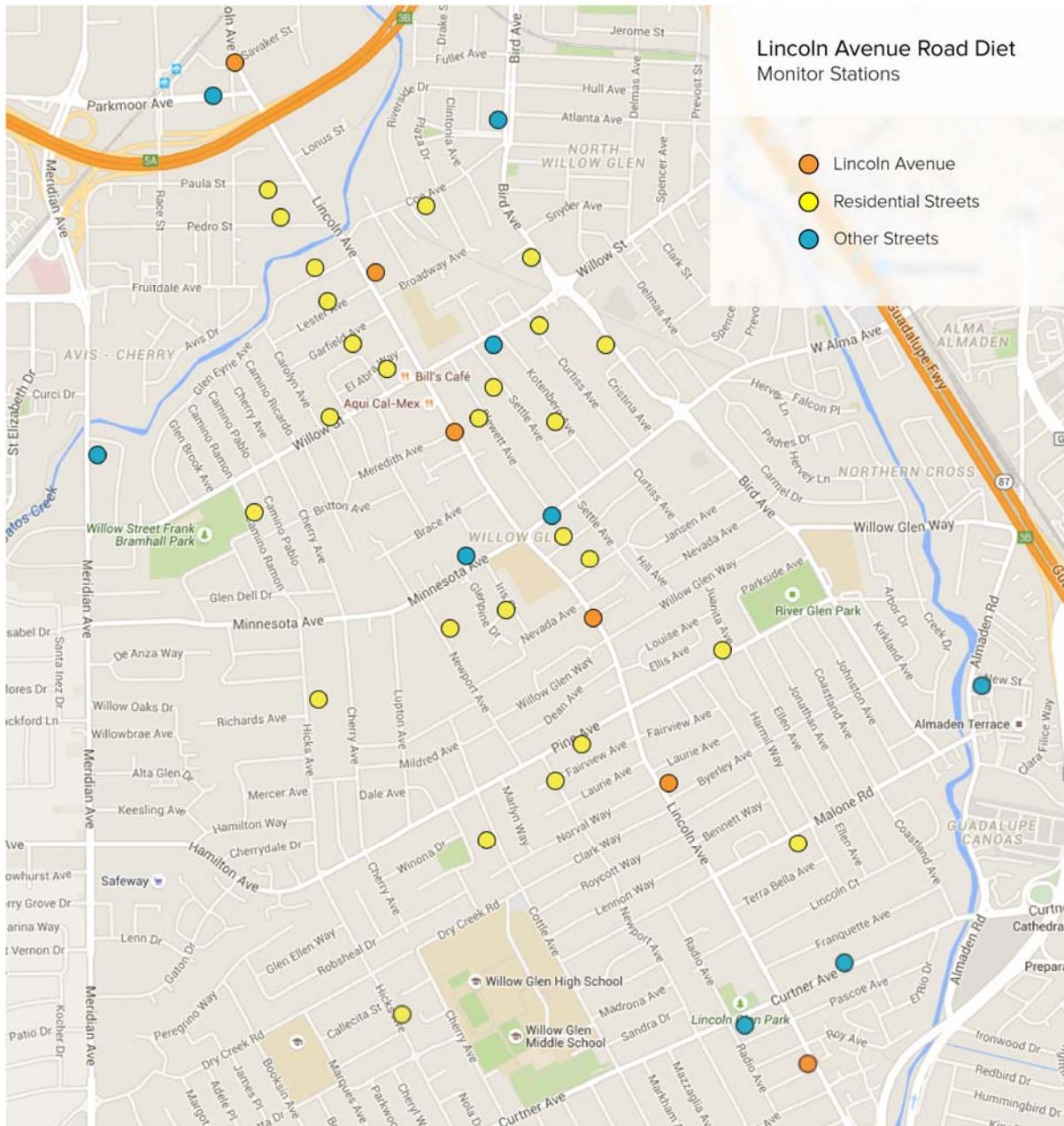
We then combined these outcomes with results from existing academic literature in order to conduct a cost-benefit analysis of the road diet. Given the current available data, we find the overall net effect of the road diet to be inconclusive. The benefits of the road diet may or may not outweigh the costs depending on three main factors: (1) the actual reductions in collisions; (2) the road diet's impact on livability for area residents; and (3) the road diet's impact on sales for Lincoln Avenue businesses.

We understand that the Lincoln Avenue Road Diet Working Group will host a public meeting on June 18, 2015, where the Department of Transportation will present its methodology and summarize the official report and the public will be given an opportunity to comment.¹⁶ Based on our study, we recommend the following next steps to the City of San Jose:

- **Clarify and prioritize the goals of the road diet** in order to better gauge whether the road diet successfully achieves its policy objectives.
- Determine the road diet's impact on Lincoln Avenue businesses by **gathering and analyzing pre- and post-diet data on business sales receipts**.
- **Survey area residents in order to gauge perceptions of the road diet's impact on livability**. This survey, which can be conducted online or door-to-door, should gather residents' views on the road diet's impact on the local traffic environment, comfort and safety for pedestrians and bicyclists, and the overall character of Lincoln Avenue and surrounding streets.
- **Gather more pedestrian and bicycle traffic count data** over a longer time period to determine if the post-diet increases are statistically significant

¹⁶ City of San Jose. Department of Transportation. (2015). *Lincoln Avenue Road Diet Trial Data Collection Report*. Retrieved from: http://willowglenroaddiet.com/pdf/DOT_Final_Lincoln%20Road%20Diet%20Report.pdf.

Appendix I: Map of Lincoln Avenue and Surrounding Streets



Created by: C Davis Designs (www.cdavisdesigns.com)

Appendix II: Breakdown of Costs from Increased Travel Time

The biggest cost of the road diet is increased travel time for drivers. We estimated this cost to be roughly \$46,140 via the following formula: value of travel time * increased travel time * occupancy per vehicle * 260 days.

- **Value of travel time**¹⁷: We calculated the value of travel time based on the annual median household income in the Willow Glen neighborhood. To calculate the value of time per hour, we divided the median household income in the area by 2,080 hours (average total working hours per year, as calculated by an average of 8 working hours per day * 260 working days per year).

The U.S. Department of Transportation (DOT) guidelines distinguishes between personal and business travel. Business travel is defined as on-the-clock business travel, for which a market wage is paid. Remaining travel, including travel to and from work, is defined as personal travel. DOT guidelines assume that business travel is worth 100% of hourly income, while personal travel is worth 50% of hourly income. According to DOT guidelines, the average distribution is estimated to be 95.4% personal and 4.6% business travel.

Willow Glen currently has a median household income of \$120,108.¹⁸ Because this is far higher than the nationwide average, the value of travel time for Willow Glen residents is much greater as well. Based on Willow Glen's median household income, business travel is worth \$57.54 per hour, while personal travel is worth \$28.87 per hour. Using DOT distribution guidelines, the average value of travel in Willow Glen is \$30.20.

- **Increased travel time**: Our analysis found an average 1 minute, 59 second decrease in travel time from 11 am to 2 pm (midday, non-rush hours), and an average 1 minute, 38 second increase in travel time from 4 pm to 7 pm (evening rush hours). Post-diet, an average of 1,719 cars traveled on Lincoln Avenue during midday hours and an average of 2,222 cars traveled on the road during evening rush hours. Therefore, all drivers combined experienced a total of 18.94 hours of time saved during the middle of the day and 20.16 hours of delay during the evening rush. Taking the average of these numbers and multiplying it by 8 working hours in a day results in a total cost of \$147.59 in lost time for all drivers on Lincoln Avenue combined each day.

¹⁷ Guidance based on: U.S. Department of Transportation. (2011). *Memorandum on Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis*. Retrieved from: http://www.transportation.gov/sites/dot.dev/files/docs/vot_guidance_092811c.pdf.

¹⁸ Willow Glen, San Jose, CA - *Lifestyle and Demographics - Realtor.com*®. Retrieved June 7, 2015, from http://www.realtor.com/local/Willow-Glen_San-Jose_CA/lifestyle.

- **Vehicle occupancy:** Assuming an average vehicle occupancy of 1.2 people,¹⁹ the average cost of increased travel time per day adds up to \$177.11.
- **Yearly basis adjustment:** Multiplying \$177.11 by 260 days and adjusting for inflation,²⁰ we estimate the total cost of increased travel time per year for all Lincoln Avenue drivers combined to be about \$46,140.

¹⁹ City of New Brunswick, New Jersey. (2014). *Costs and Benefits of a Road Diet for Livingston Avenue in New Brunswick, New Jersey*. Retrieved from: <http://thecityofnewbrunswick.org/planninganddevelopment/wp-content/uploads/sites/8/2014/04/Livingston-Ave-Road-Diet-Web.pdf>.

²⁰ 2015 yearly inflation rate was not available, so we used the inflation rate from April 2015 (0.2%) as a substitute. Calculated using: <http://www.usinflationcalculator.com/inflation/current-inflation-rates/>.

Appendix III: Breakdown of Benefits from Reduced Collisions

We estimate that the road diet could result in anywhere between \$38,816 and \$304,928 in saved costs from reduced collisions.

To arrive at these figures, we first quantified the average annual cost of injuries resulting from collisions on Lincoln Avenue using the U.S. Department of Transportation’s (DOT) guidance on value of statistical lives (VSL) and injuries. The mean VSL provided by DOT for 2015 is \$9,395,247, with low and high values of \$5,368,712 and \$13,318,536. We use all three valuations in our estimates to arrive at a range. In addition, we also use the DOT’s Abbreviated Injury Scale (AIS) to quantify each type of injury.²¹ To generate conservative estimates, we used AIS 1 for “minimal” injuries and AIS 2 for “moderate” injuries, as defined by the City of San Jose’s collision reports.

US Department of Transportation's Abbreviated Injury Scale (AIS)		
AIS Level	Severity	Fraction of VSL
AIS 1	Minor	0.003
AIS 2	Moderate	0.047
AIS 3	Serious	0.105
AIS 4	Severe	0.266
AIS 5	Critical	0.593
AIS 6	Unsurvivable	1.000

Pre-Diet Cost of Annual Collisions on Lincoln Avenue (based on VSL and AIS weights provided by DOT guidance)			
Injury severity	Low valuation	Mean valuation	High valuation
Minimal	\$16,106	\$28,186	\$39,956
Moderate	\$630,824	\$1,103,942	\$1,564,928
Total	\$646,930	\$1,132,128	\$1,604,884

We then conducted a thorough literature review of existing studies on road diets. Two studies stood out as being particularly relevant for the Lincoln Avenue road diet because they examined road diet sites in California and Washington located in areas similar to Willow Glen in terms of population, traffic counts, and location character. One study found an average 6% collision reduction rate²², while the other found a 19% reduction rate²³. While the 19% reduction rate is generally considered to be more reliable,²⁴ we used both figures to provide a high/low estimate range.

²¹ VSL and AIS guidance based on: U.S. Department of Transportation. (2014). *Memorandum on Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses*. Retrieved from: http://www.transportation.gov/sites/dot.gov/files/docs/VSL_Guidance_2014.pdf.

²² 6% collision reduction rate taken from: Huang, H., Stewart, J., & Zegeer, C. (2002). *Evaluation of Lane Reduction "Road Diet" Measures on Crashes and Injuries*. Transportation Research Record, 1784, 80-90. doi:10.3141/1784-11.

²³ For 19%, see: Harkey, D.L., R. Srinivasan, J. Baek, et. al. (2008). *Crash Reduction Factors for Traffic Engineering and ITS Improvements*. NCHRP Report 617.

²⁴ Harkey et. al. (2008) generally considered to be more reliable because it uses a larger number of reference sites, methods to control for regression to the mean (the tendency for crashes to fluctuate around a mean), changes in traffic flow, etc. Federal Highway Administration. (2013). *Road Diet*

Post-Diet Collision Reduction Savings (Based on 6% reduction rate)			
	Low valuation	Mean valuation	High valuation
Pre-diet	\$646,930	\$1,132,128	\$1,604,884
Post-diet	\$608,114	\$1,064,200	\$1,508,591
Cost savings	\$38,816	\$67,928	\$96,293

Post-Diet Collision Reduction Savings (Based on 19% reduction rate)			
	Low valuation	Mean valuation	High valuation
Pre-diet	\$646,930	\$1,132,128	\$1,604,884
Post-diet	\$524,013	\$917,024	\$1,299,956
Cost savings	\$122,917	\$215,104	\$304,928

As you can see, using high/low estimates for VSL and collision reduction results in a wide range of potential saved costs from the road diet.

One limitation to this approach is that we held injury severity levels constant for our estimates because none of the current academic literature provides disaggregated effects by collision type. As we noted earlier, there is a greater chance of injury when collisions involve pedestrians and bicyclists. However, we can't be sure of the effects of the road diet on these types of collisions. The road diet could result in lower risk for pedestrians and bicyclists given slower traffic and the addition of bike lanes on the sides of the roads. Alternatively, the increase in bicyclists and pedestrians on Lincoln Avenue could also result in a net increase in these types of collisions.