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Slow Streets! Your Streets? An Evaluation of Speed-Reducing Countermeasures on LA Slow Streets

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UCLA Institute of Transportation Studies

Slow Streets! Your Streets?

An Evaluation of Speed-Reducing Countermeasures on LA Slow Streets

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Client: Los Angeles Department of Transportation (LADOT)

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16. Abstract
The Los Angeles Department of Transportation (LADOT) initiated the Slow Streets program to create opportunities for multimodal transportation and outdoor recreation during the Covid-19 pandemic. The program initially used low-cost barricades and signage to demarcate Slow Street segments before upgrading to six new traffic calming measures, or countermeasures, in Phase 2 that were designed to reduce speeds. This report evaluated their effectiveness through analyzing StreetLight speed data and employing a custom formula comparing speed changes on Slow Street segments to estimate each countermeasure's speed-reducing effect. Nearly half of the segments experienced speed increases after countermeasure installation. Though it was difficult to attribute these speed increases to any reasons with certainty, we speculate that the countermeasures may not have caused great enough changes in street geometries to significantly alter driver behaviors and reduce speeds. Drivers may be using Slow Street segments to "cut through" traffic, and Slow Streets may not have been able to evade speed increases that have occurred on many streets during and after Los Angeles' stay-at-home orders went into effect. Based on the results, LADOT should prioritize the installation of treatments located at or near intersections, which have shown to be most effective. LADOT should also reduce lane widths on entire street segments rather than at certain points along the street and consider alternative materials to work around current design restrictions. Finally, LADOT should perform a qualitative study of the effectiveness of the program and improve information access of the Slow Streets network by publishing interactive maps online.

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Disclaimer

This report was prepared in partial fulfillment of the requirements for the Master in Urban and Regional Planning degree in the Department of Urban Planning at the University of California, Los Angeles. It was prepared at the direction of the Los Angeles Department of Transportation (LADOT) as a planning client. The views expressed herein are those of the authors and not necessarily those of the Department, the UCLA Luskin School of Public Affairs, UCLA as a whole, or the client.

Slow Streets! Your Streets?

An Evaluation of Speed-Reducing Countermeasures on LA Slow Streets

Jackson Zeng
Client: Los Angeles Department of Transportation (LADOT)
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University of California, Los Angeles
2023

A comprehensive project submitted in partial satisfaction of the requirements for the degree Master of Urban and Regional Planning

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Executive Summary

The Los Angeles Department of Transportation (LADOT) initiated the Slow Streets program to create opportunities for multimodal transportation and socially-distant outdoor recreation during a time when many were experiencing cabin fever from quarantining in the Covid-19 pandemic. The program started out using low-cost simple barricades and signage to demarcate Slow Street segments before upgrading to six new traffic calming measures, or countermeasures, that used more durable materials such as striping, signage, and bollards in Phase 2. These six countermeasures are listed as follows:

- Centerline Gateway Treatment
- Signage & Street Markings
- Traffic Circle
- Painted Median
- Signal Gateway Treatment
- Intersection Tightening

The countermeasures were intentionally designed to slow down vehicles, and this report evaluated their effectiveness through analyzing StreetLight speed data and employing a custom formula comparing speed changes on Slow Street segments to estimate the individual speed-reducing effect of each countermeasure.

The study revealed that nearly half of all analyzed Slow Street segments experienced speed increases after the countermeasures were installed. Most street segments experienced speed increases of 1 to 2 MPH, but some experienced much greater increases of up to 8 MPH. Since this was not a controlled experiment, it was difficult to attribute these speed increases to any reasons with certainty, but we can make the following speculations:

- **Countermeasures lacked aggressiveness in their design:** The countermeasures did not cause great enough changes in street geometries to significantly alter driver behaviors and reduce speeds
- **“Cut-through” traffic led to high speeds:** Drivers may be using Slow Street segments to “cut through” traffic after traffic volumes returned to pre-pandemic levels
- **Speeds everywhere have increased:** Speeds have increased on most streets during the pandemic that have persisted even after Los Angeles’ stay-at-home orders were lifted, and Slow Streets are no exception

Based on the results, LADOT should consider the following recommendations for improving the effectiveness of the Slow Streets program:

- **Continue with what works:** Prioritize the installation of Centerline Gateway Treatments, Traffic Circles, Signal Gateway Treatments, and Intersection Tightening, which have shown to be most effective
- **Extend lane width reductions:** Reduce lane widths on entire street segments rather than just at certain points along the street to encourage slow speeds throughout the street
- **Reconsider design constraints:** Use alternative designs and materials, such as rubber curbs instead of bollards, to work around current countermeasure design restrictions
- **Collect qualitative data:** Observe driver behavior and conduct interviews for a more qualitative view of the effectiveness of the program
- **Improve the public's access to Slow Streets:** Make information on the Slow Streets network accessible by publishing interactive maps of the Phase 2 segments and overall Slow Streets network or collaborating with online map services like Google Maps

Introduction

Towards the onset of the Covid-19 pandemic, many parks and other recreational areas in Los Angeles closed to help control the spread of the virus, leaving residents with few options for outdoor activity. In response, the Los Angeles Department of Transportation (LADOT) initiated a program called Slow Streets on May 15, 2020 that implemented low-cost signage and barricades along certain streets with the intent to designate spaces for recreation and slower modes of travel like walking and biking.

Only certain eligible organizations could nominate sets of streets to be designated as Slow Streets. This included school or parent-teacher associations, neighborhood councils, local nonprofit/community-based organizations, homeowners associations, council districts, religious organizations, business improvement districts, business associations, and block clubs. These community sponsors helped LADOT by evaluating the feasibility of implementing countermeasures on the streets, communicating the proposed changes to local stakeholders, and maintaining the Slow Streets network.

As the initial low-cost materials wore out, LADOT received direction from the Los Angeles City Council on November 4, 2020 to divert resources from installing new Slow Streets to revamping existing Slow Street infrastructure. This initiated Phase 2 of the Slow Streets program, and LADOT met with community partners to identify and implement more durable materials and countermeasures that were designed specifically to eliminate or reduce speeding on these streets. LADOT also developed an equity framework to establish a prioritization scheme for the countermeasure improvements.[1] Ultimately, LADOT developed the following six countermeasures for Phase 2 of the program that each used a combination of striping, signage, and bollards:

- Centerline Gateway Treatment
- Signage & Street Markings
- Traffic Circle
- Painted Median
- Signal Gateway Treatment
- Intersection Tightening

For this client project, LADOT was interested in evaluating the effectiveness of the Phase 2 countermeasures at reducing or eliminating vehicle speeding on Slow Streets. To do

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[1] The equity framework considered six safety and social equity metrics: (1) whether the network is within a Slow Street Target Neighborhood defined during Phase 1 (communities most impacted by lack of open space during the pandemic), (2) population density, (3) income, (4) Los Angeles Countywide Parks and Recreation Needs Assessment score, (5) proximity to a High Injury Network street, and (6) total collisions within a quarter-mile of the network area.

this, I analyzed StreetLight data and compared vehicle speeds before and after the implementation of the countermeasures. I compared the *Before* condition with two sets of *After* conditions: (1) one month after the countermeasures were installed (*1 Month After Installation*), and (2) the most recent three months of StreetLight data available (*October - December 2022*). To estimate the individual effectiveness of each countermeasure, I employed a formula that estimated the difference in average speed due to the countermeasure by examining speeds between an analysis and comparison street with different quantities of unique countermeasures.

The analysis revealed that some Slow Street segments experienced increases in speed after the implementation of the countermeasures. Additionally, for streets that experienced an increase in speed, a greater proportion of speeds exceeded LADOT's recommended speed on Slow Streets of 15 MPH. Traffic Circles appeared to be the most effective at reducing speeds, while Painted Medians were the most ineffective.

Although the reliability of StreetLight data appeared questionable on certain occasions, nearly half of the Slow Streets segments analyzed experienced increases in average speed, raising concerns about the effectiveness of countermeasures. As this was not a controlled experiment, the reason behind these increases in speed was not clear, and further analysis of congestion and volume data at one Slow Street location failed to reveal a correlation with speed. Interestingly, in some cases, non-Slow Street segments experienced greater reductions in average speed than Slow Street segments.

One possible explanation for why the countermeasures may not have been effective is that changes in street geometry were not drastic enough to alter driver behavior. It is also possible that drivers may be using Slow Streets as shortcuts to cut through traffic, and the countermeasures simply do not do enough to discourage this behavior. However, the simplest explanation is that emptier streets during the pandemic has allowed for faster driving that has persisted even after stay-at-home orders were lifted, and Slow Streets have not been an exception to this larger trend.

Based on the results, LADOT may consider prioritizing the installation of countermeasures that provide treatments at the intersection (as opposed to within the segment), as these led to the greatest estimated reduction in speed. LADOT should also consider reducing lane widths on entire segments to promote slow speeds throughout the street or using alternative designs and materials to work around current design restrictions. LADOT could also observe driver behavior and conduct interviews to provide a more holistic view of the effectiveness of the program. Finally, LADOT should publish an interactive map of the Phase 2 street segments and overall Slow Streets network or explore collaborating with online map services like Google Maps to improve residents' ability to find and access these streets.

Literature Review

Drivers typically misjudge their own safety while driving, and underestimating the frequency with which they speed is one example. This paradox raises a large public health issue, as unsafe driving creates dangerous conditions for all other street users by increasing their risk of severe or fatal injuries. Planners and engineers have often responded to speeding concerns by employing design interventions called traffic calming measures, or countermeasures. Countermeasure effectiveness has been analyzed in previous studies through comparing safety metrics before and after the implementation of the treatment. However, the specific effectiveness of each countermeasure is not a guarantee, as it may vary based on the context within which it is implemented.

Drivers tend to think highly about how safe they drive, whether or not such a judgment is valid. Early research on this topic by Naatanen and Summala (1975) suggested that most drivers perceived to be better at driving than the average driver. Later studies supported this conclusion, such as a study by Svenson (1980) where between 70 to 80 percent of drivers considered themselves as having safer driving habits than the average driver. Other studies affirmed that the perception of drivers on their own safety seemed to be self-enhancing, with a study by Walton and Bathurst (1998) finding that 85 to 90 percent of drivers surveyed perceived to drive slower than the typical driver.

When thinking specifically about speed, such misperceptions by drivers about how fast they tend to go could be endangering the safety of all other street users. Specifically, speeding makes for an unsafe street environment as it places active transportation users at much greater risk of injury or fatality. Studies have found that pedestrian safety was highly correlated with driving speeds, with a pedestrian's risk of fatality increasing by nearly eight- to nine-fold when colliding with a vehicle traveling at about 30 MPH compared to about 20 MPH (Pasanen, 1993; Donnell et al., 2009). This increase is even more significant for those aged 60 and above, who experience an estimated 21-times greater risk of fatality from such a change in speed (Donnell et al., 2009). Additionally, higher speeds have also been linked to increases in the frequency of pedestrian collisions, with one study finding that an increase in speed of about 6 MPH correlated with an estimated 48 percent increase in the number of fatal pedestrian collisions (Anderson et al., 1997).

To tackle safety issues on streets, transportation planners and engineers commonly employ design interventions called traffic calming measures, or countermeasures. These involve making changes to street conditions and infrastructure to minimize safety risks for all street users. With respect to pedestrian safety, Retting et al. (2003) has grouped available countermeasures into three broad classifications that either (1) separate vehicles from pedestrians temporally or spatially, (2) increase visibility of pedestrians, or (3) reduce vehicle speeds. For this project, all countermeasures installed by LADOT in

Phase 2 of their Slow Streets program fall under this third classification of reducing vehicle speeds.

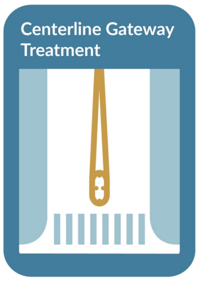
Countermeasures are often evaluated for their effectiveness through an analysis that compares a safety metric both before and after the countermeasure is implemented. For example, a study on the effectiveness of countermeasures that aimed to reduce the frequency of red-light-running incidents compared the number of collisions at intersections in the three years prior to the countermeasure implementation with the directly-observed frequency of incidents during the time of the study (Bonneson et al., 2002).

However, locational context may be a significant factor in determining whether countermeasures are able to achieve their anticipated safety benefits (Melcher et al., 2001). For example, one study in King County, Washington found that collision severity increased on city streets with higher residential density, demonstrating how the extent of safety improvements needed may differ from street to street (Moundon et al., 2011). Further research is needed to understand the impact of environmental factors on speeding tendencies specifically, but nevertheless, locational differences in safety risk present questions about the ability to apply lessons from location-specific countermeasure effectiveness studies to different street contexts.

In some ways, driving conditions in Los Angeles are unique compared to many other cities due to its historically car-centric urban form and relatively moderate population density across a sprawling landscape. The city also has large-scaled transportation safety issues. Data from the California Office of Traffic Safety (2019) reveals that Los Angeles is ranked first in total number of fatal or injurious collisions and second in speed-related fatal or injurious collisions out of 15 California cities with populations over 250,000. Due to this, it may be misleading to assume that countermeasures that work in other cities would be similarly effective in Los Angeles. The opposite may also be true, as the countermeasures implemented by LADOT may be specifically catered to fit the city's specific urban form and safety issues and could lead to varying levels of success when applied more broadly to other cities and regions. Thus, as this research evaluates solutions to speeding on Los Angeles streets, with data and observations coming from primarily residential streets in the city, the recommendations proposed should also principally be applied to the Los Angeles context.

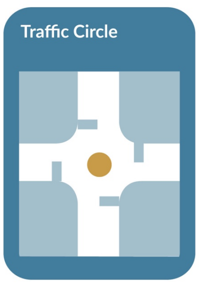
Background

The countermeasures can be separated into two categories: (1) treatments located at or near the intersection and (2) treatments located along the street segment. Shown below are diagrams of each of the countermeasures and descriptions of their benefits.

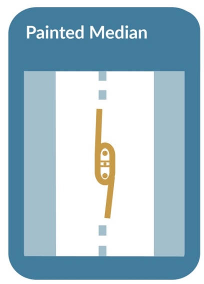


- Improves physical delineation of the two opposing travel lanes
- Encourages slower speeds for vehicles traveling through the street
- Demarcates the entrance to Slow Street segments

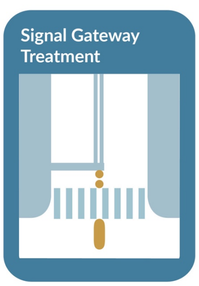
- Alerts drivers of the 15 MPH speed limit of the street segment
- Reminder for drivers to maintain slow speeds and for all road users to exercise caution



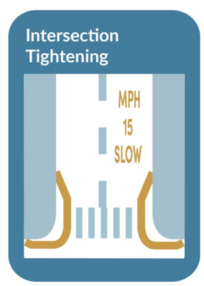
- Slows speeds of vehicles traveling through the intersection
- Reduces the risk of serious collisions at unsignalized intersections



- Encourages reductions in speed by introducing a curved obstacle in an otherwise straight street



- Slows speeds by encouraging drivers to make sharper turns when turning into and out of a signalized intersection



- Reduces the radii of intersection corners to slow vehicles turning into and out of the street
- Improves visibility of pedestrians crossing at the intersection

Figure 1: Slow Streets Phase 2 countermeasures.

At the time I performed the analysis for this report, LADOT had installed countermeasures at twelve Slow Streets locations, with each location containing between four to nine street segments. The locations of these Slow Streets are shown in the following maps:

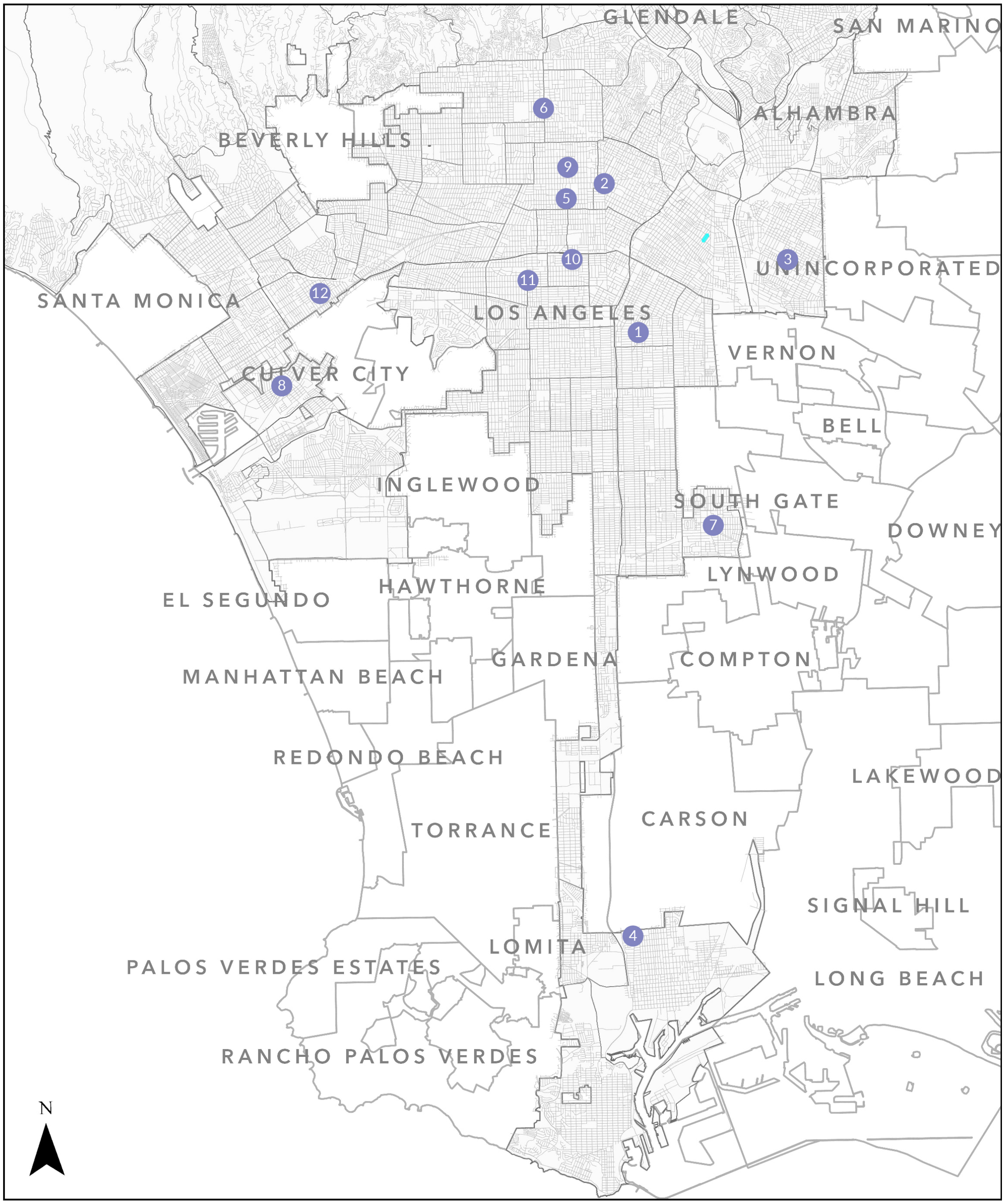


Figure 2: Overview map of Slow Streets locations.

Figure 3: Maps of Slow Street locations and analyzed street segments.

LADOT developed a series of criteria for which Slow Streets locations could be upgraded with new countermeasures in Phase 2 of the program as well as guidelines for their design. A summary of these criteria and guidelines can be found in Appendix A. LADOT also had guidelines for the installation of these new countermeasure treatments in the toolkit shown in Appendix B.

Methodology

I analyzed StreetLight speed data before and after the individual installation dates of the countermeasures for all twelve Slow Street locations. I performed analysis for two separate *After* time periods: (1) one month after the installation date, and (2) the most recent three months of StreetLight data available (October to December 2022).

I then compared speed data results between street segments within the same Slow Street location to study the effectiveness of each individual countermeasure at reducing speeds. For example, if Street Segment A had one instance of Signage & Street Markings, and Street Segment B had one instance of Signage & Street Markings and one instance of a Centerline Gateway Treatment, I attributed any additional change in speed from Street Segment B compared to A to the additional Centerline Gateway Treatment countermeasure.

About the Data

Prior to May 2022, the primary source of data for StreetLight came from location-based services (LBS) trips. StreetLight obtained this data through a supplier called Cuebiq that provides pieces of software (SDKs) to mobile app developers to facilitate location-based services. These apps then collect anonymous location data from users whenever the apps are actively being used or operate in the background. In May 2022, StreetLight changed its primary data source to connected vehicle data (CVD) while still using LBS trips as features. Through this new dataset, StreetLight generates trips using pings from personal vehicles containing location technology, allowing for more accurate classification of vehicle trips versus other modes than with LBS data.

The *Before* analysis period extends from the installation date back to one year prior to the installation date. However, as StreetLight changed its primary data source on May 1, 2022, I avoided combining data from different sources by adjusting the *Before* analysis period for some Slow Street locations. Specifically, if the installation date came after May 1, 2022, the first date of the *Before* analysis period was set as May 1, 2022 instead of exactly one year before the installation date.

For each street segment, I calculated and tabulated the change in average speed for the two sets of comparisons:

(1) Before period versus one month after the countermeasures were installed (*1 Month After Installation*)
(2) Before period versus the most recent three months of StreetLight data available (*October - December 2022*)

For the simplest analysis case where the analyzed Slow Street segment had only one unique countermeasure compared to its comparison street,[2] I averaged the differences in speeds to estimate the effect of each individual countermeasure at reducing speeds. For streets where there was more than one unique countermeasure compared to its comparison street, I estimated the sample effect of the study countermeasure using the calculations of other countermeasures and the following formula:

$$x_{CM} = \Delta s \pm \sum_{i=1}^{m} n_{i,comparison} \times x_i$$

where:

- i is a unique type of countermeasure that exists in surplus or shortage on the comparison street compared to the analysis street
- x_{CM} is the sample effect of the study countermeasure
- Δs is the change in average speed between the compared pair of streets
- $n_{i,comparison}$ is the number of i countermeasures in surplus or shortage on the comparison street compared to the analysis street
- x_i is the final estimated effect of countermeasure i

The $\pm$ term became additive or subtractive depending on whether the analysis street had a shortage or surplus of countermeasure i, respectively, compared to the comparison street.

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[2] For example, I compared Francis Avenue to Leeward Avenue to study the effect of the Signage & Street Markings countermeasure. The two streets had essentially the same countermeasures, other than that the former street had one additional Signage & Street Markings countermeasure. I subtracted the change in speed on Leeward Avenue by the change in speed on Francis Avenue, and the resulting difference was considered to be one sample datapoint of the effect of the Signage & Street Markings countermeasure. Then, as mentioned before, to calculate the final estimated effect of the Signage & Street Markings countermeasure, I averaged the differences of all comparison pairs with that study countermeasure.

To demonstrate this process, consider the following example:

Sample Effect of Countermeasure Example Calculation

To calculate a sample effect of the Traffic Circle countermeasure, I compared the speed change in the North Serrano Avenue Slow Street segment (the analysis street) against the North Saint Andrews Place Slow Street segment (the comparison street). The segments have the following countermeasures:

- North Serrano Avenue (analysis): 3 Signage & Street Markings, 1 Traffic Circle
- North Saint Andrews Place (comparison): 2 Signage & Street Markings

The differences in average speed for the two sets of comparisons for North Serrano Avenue are as follows:

- Before versus 1 Month After Installation: -1 MPH
- Before versus October - December 2022: -2 MPH

As can be seen, apart from the additional Traffic Circle countermeasure, North Serrano Avenue also has an additional Signage & Street Marking countermeasure. Based on previous calculations (see footnote 2), I estimated the effect of the Signage & Street Markings countermeasure to be 0.625 MPH for the *Before versus 1 Month After Installation* comparison and -0.125 MPH for the *Before versus October - December 2022* comparison. To isolate the effect of the Traffic Circle countermeasure, I subtracted out the effect of this additional Signage & Street Marking countermeasure.

Before versus 1 Month After Installation Comparison:

$$x_{Traffic\ Circle,1\ Month} = \Delta s_{1\ Month} - n_{Signage\ \&\ Striping,comparison} \times x_{Signage\ \&\ Striping,1\ Month}$$

$$x_{Traffic\ Circle,1\ Month} = -1\ MPH\ -\ 1\ \times 0.625\ MPH = \ -1.625\ MPH$$

Before versus October - December 2022 Comparison:

$$x_{Traffic\ Circle,Oct-Dec\ 2022} = \Delta s_{Oct-Dec\ 2022} - n_{Signage\ \&\ Striping,comparison} \times x_{Signage\ \&\ Striping,Oct-Dec\ 2022}$$

$$x_{Traffic\ Circle,Oct-Dec\ 2022} = -2\ MPH\ -\ 1 \times\ -0.125\ MPH = \ -1.875\ MPH$$

Thus, I estimated the sample effect of the Traffic Circle countermeasure to be -1.625 MPH for the *Before versus 1 Month After Installation* comparison and -1.875 MPH for the *Before versus 1 Month After Installation* comparison.

Using this method, it was theoretically possible for all streets to be compared against each other by simply adding and/or subtracting countermeasures. Recognizing this, I only compared street segments belonging to the same Slow Street location. Establishing this restriction had the added benefit of reducing any potential confounding variables that may have appeared if street segments from different Slow Street locations were compared. I also limited the number of unique surplus or shortage countermeasures, including the analysis countermeasure, between compared streets to three. For example, in the Historic South Central Slow Street location, Woodlawn Avenue could be compared to Wall Street, as they differed in their number of Traffic Circles, Signage & Street Markings, and Centerlines (3 unique countermeasures), but Woodlawn Avenue could not be compared to 42nd Place as they differed in their number of Centerline Gateway Treatments, Signage & Street Markings, Traffic Circles, and Painted Medians (4 unique countermeasures). Once again, I applied these restrictions to increase the robustness of the analysis.

Results

Several of the analyzed Slow Street segments experienced increases in average speed for either one or both of the *1 Month After Installation* and *October - December 2022* analysis periods. These positive changes in speed are highlighted in blue in Table 1 below.

Table 1: Change in Average Speed

Location	Street Segment	Change in Average Speed (MPH)	
		1 Month After Installation	October - December 2022
1. Historic South Central	Wall St	3	4
	Woodlawn Ave	-1	2
2. MacArthur Park	Leeward Ave	1	4
	Francis Ave	8	0
	Magnolia Ave (S)	0	0
	Coronado St	0	1
	4th St	-1	-1
3. Boyle Heights	Inez St	2	-9
	Evergreen Ave	1	5
4. Wilmington Ave	Van Tress Ave	2	0
	Frigate Ave	-2	2

5. Koreatown KIWA	Hobart Blvd	0	1
	Catalina St	1	0
6. Hollywood	N St Andrews Pl	0	1
	Lemon Grove Ave	0	-1
	Oxford Ave	-2	-1
	N Serrano Ave	-1	-1
	Sierra Vista Ave (E)	-2	-1
7. Watts	Graham Ave	1	0
	105th St	2	0
	106th St	0	2
	107th St (E)	-1	2
	107th St (W)	0	0
	Santa Ana Blvd	0	2
9. Koreatown Berendo	Hobart Blvd	0	2
	Berendo St	2	2
	New Hampshire Ave	-1	2
10. Adams-Normandie	22nd St	1	2
	23rd St	-2	-2
	25th St	-1	-1
11. Jefferson Park	29th St	1	7
	31st St	-2	-1
12. Palms	Mentone Ave	0	0
	Vinton Ave	1	0
	Tabor St	1	0

As we can see, 14 of the 35 segments analyzed experienced increases in speed for the *1 Month After Installation* analysis period. This number increased to 16 of 35 segments for the *October - December 2022* analysis period. Most street segments experienced speed increases of 1 to 2 MPH, but some segments experienced increases of up to 8 MPH. Six segments had speed increases for both analysis periods, and 15 segments had greater speed increases in the *October - December 2022* compared to the *1 Month After Installation* analysis period.

Although average speeds increased on some Slow Street segments, this was not necessarily a sign that the countermeasures were ineffective, as solely analyzing averages could overshadow other trends in the data. For example, the recommended speed by LADOT along Slow Streets is 15 MPH (LADOT, 2023b); if many more vehicles traveled under 15 MPH after the countermeasures were installed, and only a small percentage of vehicles traveled much faster than 15 MPH, the average speed could still increase despite the countermeasures causing many more drivers to slow down. Therefore, it is perhaps more valuable to analyze the change in the proportion of trips along Slow Street segments equal to or under LADOT's recommended speed of 15 MPH. Table 2 shows the change in the proportion of trips with speeds of 14 to 16 MPH or below in all streets that experienced an increase in average speeds in the *October - December 2022* analysis period.

Table 2: Change in Proportion of Speeds ≤14-16 MPH

Location	Segment	Change in Proportion of Speeds ≤14-16 MPH
1. Historic South Central	Wall St	-29%
	Woodlawn Ave	-12%
2. MacArthur Park	Coronado St	-8%
	Leeward Ave	-17%
3. Boyle Heights	Evergreen Ave	-27%
4. Wilmington	Frigate Ave	-17%
6. Hollywood	N St. Andrews Pl	-2%
7. Watts	E 106th St	-17%
	E 107th St (E)	-8%
	Santa Ana Blvd	-7%
9. Koreatown Berendo	Berendo St	-4%
	Hobart Blvd	-19%
	New Hampshire Ave	-2%
10. Adams-Normandie	W 22nd St	-5%

Note that *5. Koreatown KIWA* and *11. Jefferson Park* are omitted as they both had missing data.

As we can see, several streets experienced slight decreases of five percent or less in the proportion of speeds within LADOT's recommended speed. However, all 14 street segments analyzed experienced decreases in the proportions of trips that traveled within 14 to 16 MPH. That is, this deeper analysis into the speed data revealed that for all streets that experienced an increase in average speed, a greater percentage of trips exceeded LADOT's recommended speed of 15 MPH along Slow Streets after the installation of the countermeasures.

We can also look at how the distribution of speeds compare before and after the countermeasures were installed. Figure 4 below shows the cumulative distribution of speeds for the *October - December 2022* comparison for all streets that experienced an increase in average speed. Steep portions of the curve indicate a greater proportion of speeds in that corresponding interval. The blue vertical line on each graph indicates the recommended LADOT speed interval of 14 to 16 MPH.

Figure 4: October - December 2022 comparison for all streets that experienced an increase in average speed.

For all segments, the curve has generally shifted to the right after the installation of countermeasures. Additionally, the curves for some segments like North Saint Andrews Place and Santa Ana Boulevard have seemingly maintained the same overall shape but shifted entirely to the right, suggesting that all trips along that segment experienced a nearly identical magnitude of increase in speed. Many curves also became shallower towards their left end, revealing that a smaller proportion of trips traveled at the lowest speeds of the distribution compared to before.

A summary of the average change in speed attributed to each countermeasure appears in Table 3. Appendix C shows more detailed tables with the average change in speed attributed to each countermeasure broken down by the analyzed street segments.

Table 3: Average Change in Speed Attributed to Each Countermeasure

Countermeasure	**Average Change in Speed**	
	1 Month After Installation	**October-December 2022**
Intersection Tightening	0.083	-0.167
Signal Gateway Treatment	-1.813	-0.563
Traffic Circle	-0.625	-1.542
Centerline Gateway Treatment	0.500	-1.000
Painted Median	1.250	5.000
Signage + Street Markings	0.625	-0.125

The results suggest that the Signal Gateway Treatment countermeasure was most effective at reducing speeds for the *1 Month After Installation* analysis period. Interestingly, Traffic Circle was the only other countermeasure that led to an estimated decrease in speeds during this analysis period. Traffic Circles also led to the largest decrease in speed in the *October - December 2022* analysis period, suggesting that they may successfully maintain their effectiveness months after their installation. Meanwhile, Painted Medians were the most ineffective at reducing speeds for both analysis periods. Other than Painted Medians and Signal Gateway Treatments, all other countermeasures led to a larger reduction of speeds during the *October - December 2022* compared to the *1 Month After Installation* analysis period.

Limitations

This project used StreetLight as the sole datasource for analysis, so the accuracy of the results was inherently limited to the accuracy of StreetLight data. There were instances when StreetLight data appeared to be incorrect. For example, as displayed in Figure 5, data showed that there was a substantial share of trips on Inez Street with speeds greater than 30 MPH (and up to 46 MPH) before the installation of the countermeasures. This is questionable, as the upper range of speeds on Inez Street is much greater than that of other Slow Street segments, which typically had a maximum of around 30 MPH. Additionally, the Inez Street segment is only 30 feet wide, 375 feet long, and does not have an outlet on its east end, as shown in Figure 6. Therefore, it is unlikely that there were actually a significant number of vehicles traveling at such high speeds on Inez Street as the data suggested.

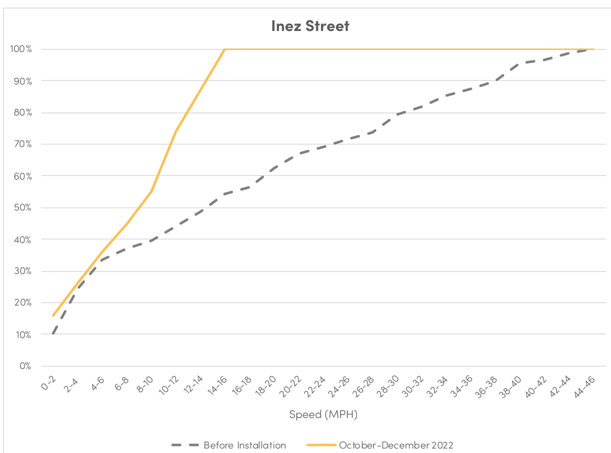

Figure 5: Data on Inez Street appears incorrect.

Figure 6: Inez Street is only 30 feet wide, 375 feet long, and is a no-outlet segment.

The increase in speed on some Slow Street segments was particularly interesting. In an attempt to uncover the reasoning behind this phenomenon, I tested hypotheses of potential variables that could have affected speed, but it was challenging to identify trends that suggested a correlation with speed.

For example, increased congestion and higher traffic volumes could have naturally slowed down vehicles regardless of whether countermeasures were present. Therefore, I decided to calculate the correlation between (1) congestion and speed and (2) volume and speed using Slow Street segments and adjacent non-Slow Street segments at the Koreatown KIWA location as samples. Table 4 shows the results of that test.

Table 4: Change in Average Speed, Congestion, and Daily Volume in Koreatown KIWA

Street Segment	Change in Average Speed	Change in Average Congestion	Change in Average Daily Volume
S Serrano Ave	1	-19%	-882
**S Hobart Blvd	2	15%	-61
S Harvard Blvd	0	-10%	-4727
S Kingsley Dr	0	-8%	-801
S Ardmore Ave	1	0%	76
Irolo St	0	-2%	-1684
S Normandie Ave	0	-19%	-1177
S Mariposa Ave	-3	12%	-311
Fedora St	-6	-9%	-203
S Kenmore Ave	-6	40%	-301
**S Catalina St	0	-2%	-68
S Berendo St	1	-8%	-1785
**San Marino St	0	18%	-19
Pearson Correlation Coefficient (*r*) with Change in Average Speed	–	-0.42	-0.20

**This street is a Slow Street segment.

In the table, increases or decreases in the corresponding variable are denoted by a blue or red highlight, respectively. Simply glancing at each row, there is not an immediately clear pattern between the change in average speed and the change in congestion nor the change in volume. The Pearson correlation coefficient (*r*) – which measures the strength of the linear correlation between variables, where -1 or 1 indicates a strong linear correlation and 0 indicates no linear correlation – was also calculated for both relationships, and the low absolute values of *r* suggest a weak linear correlation for both relationships. Therefore, changes in congestion and volume were seemingly unsuccessful explanations of speed changes.

Additionally, in order to measure the true speed-reducing effectiveness of countermeasures, data would also need to be collected for the counterfactual case, or an opposite scenario where countermeasures were *not* installed on Slow Streets. Since this is infeasible, I instead chose to calculate countermeasure effectiveness by comparing Slow Street segments with each other, which assumed that the countermeasures were effective to begin with, even if this was not always true.

In fact, in some cases, non-Slow Street segments experienced greater decreases in speed than Slow Street segments within the same Slow Street location. For example, in Table 4, the change in average speed for Slow Street segments in the Koreatown KIWA location ranged from a zero to 2 MPH increase, whereas non-Slow Street segments experienced a 6 MPH decrease to a 1 MPH increase in average speeds. Since it is inconclusive that the countermeasures are inherently effective, the effectiveness analysis results from this study may be better used as a comparative ranking of countermeasures rather than as absolute measures of effectiveness.

Finally, other factors may have also led to speed changes on Slow Streets. For example, the designation of these streets as Slow Streets may have induced slower speeds from those who are aware that they may encounter more non-vehicle users on the street. Additionally, the pandemic certainly contributed to increased speeding, as will be discussed later. These and other confounding variables complicate our ability to measure the true effectiveness of the countermeasures on their own. Thus, LADOT or other agencies may want to perform additional analyses of countermeasure effectiveness under more controlled environments to confirm the results of this study.

Discussion

It is possible that the countermeasures have not caused large enough changes to the street geometry to affect driver behavior. For example, one proven strategy to slow drivers is to decrease the width of travel lanes, which has the effect of increasing drivers' perceived risk when speeding (Liu, Wang, and Fu 2016). LADOT has integrated this strategy in some of its Slow Streets countermeasures, such as the Centerline Gateway Treatment and Painted Median that effectively shrink lane widths. However, these countermeasures only reduce lane widths at the points where they are located, whereas the rest of the segment remains wide and vulnerable to speeding. Thus, it is possible that any reduction in speeding due to the countermeasure is not sustained across the entire street segment.

While simply analyzing speed data does not reveal why speeds have increased, we can speculate why some segments in particular have experienced such changes. One reason could be that these segments facilitate “cut-through” traffic that allow for shortcuts to intersecting streets. For example, the Wall Street segment intersects Martin Luther King Jr Boulevard and San Pedro Place, both of which are arterial streets that provide access to many destinations and may have experienced increased congestion after stay-at-home orders were lifted. Because of this, drivers hoping to save time on their trip to one of these destinations could “cut through” traffic by speeding along Wall Street instead. Even with the countermeasures in place, speeding may still occur along Wall Street if it serves as a viable shortcut to avoiding traffic on nearby congested streets.

Another example of a street that may be used as a “cut through” is Frigate Avenue, which is a Slow Street segment that provides access to the Pacific Coast Highway (PCH) about a quarter mile south. If we analyze the signalization of streets with entrances to the PCH in that area, Frigate Avenue has stop-controlled intersections, whereas nearby streets, such as Figueroa Street and Wilmington Avenue, have signalized intersections. Traffic queues likely clear faster at stop-controlled intersections compared to signalized ones, so drivers may have greater opportunities to speed along Frigate Avenue as they would be able to travel longer distances before reaching the end of a queue on that street compared to on neighboring streets.

Aside from these speculations, there also lies the fact that speeding has simply become more commonplace since the pandemic. At the beginning of the pandemic, LADOT General Manager Seleta Reynolds noted on Twitter that drivers were traveling 12 percent faster on average, with some driving up to 25 percent faster (Reynolds, 2020). National data has also shown that speeding, in addition to other risky driving behaviors, has persisted even as traffic has returned to near pre-pandemic levels (Insurance Institute for Highway Safety, 2022). As drivers may have become more accustomed to driving fast during the pandemic, it is possible that the current countermeasures have not been significant enough interventions to change driver behaviors and deter speeding on Slow Streets.

However, even if the countermeasures have not been as effective at reducing speeds as hoped, there are still benefits to their presence. For one, the countermeasures provide more consistent and tactile signals to drivers to exercise caution throughout the street compared to the Phase 1 signage and barricades, which were only placed at the street ends. These effects may ultimately increase the sense of comfort and safety for non-driving Slow Streets users and contribute to LADOT’s Vision Zero mission of protecting the most vulnerable road users against severe traffic injuries and fatalities (LADOT, 2023c). Additionally, improvements to the Slow Streets network also promotes the idea that streets can be designed to serve non-driving users as much as driving ones.

Residents may become more accustomed to the benefits of open or multipurpose streets, which may ultimately increase public approval of other larger scale Complete Streets proposals in the city. These are, however, simply speculations, and further research would be needed to evaluate individuals' perceptions on the Slow Streets countermeasures and program in general.

Recommendations

As treatments located at or near intersections led to the greatest estimated decrease in speed in the results, LADOT may consider prioritizing these countermeasures at locations that meet the installation criteria. These include Traffic Circles, Signal Gateway Treatments, Centerline Gateway Treatments, and Intersection Tightening. Signage & Street Markings may reduce speeds, but only minimally. Additionally, Painted Medians may not be effective at reducing speeds, possibly because they do not do enough to affect driver behaviors, as previously mentioned. However, expanding both the width and length of Painted Medians may increase their effectiveness.[3]

Since Traffic Circles were the most effective countermeasure, LADOT should consider installing these wherever possible. Table 5 lists all locations where two Slow Street segments intersect one another, are 4-way-stop controlled, and do not currently have Traffic Circles. These are intersections that may be good candidates for Traffic Circles, but clearly, LADOT would have to perform closer reviews of each to confirm that they are suitable for such treatments.

Table 5: Intersections to Consider Traffic Circles

Location	Street	Cross Street
4. Wilmington	Frigate Ave	Don St
	Frigate Ave	Chandler St
6. Hollywood	Romaine St	Oxford Ave
9. Koreatown Berendo	Hobart Blvd	4th St
	Berendo St	4th St
11. Jefferson Park	6th Ave	30th St
12. Palms	Mentone Ave	Tabor St
	Mentone Ave	Regent St
	Vinton Ave	Tabor St

[3] While it is likely that Painted Medians may not have been effective at reducing speeds, the result that suggested they induced an *increase* in speeds is perhaps questionable. Further analysis would be needed to confirm this finding.

Additionally, instead of using countermeasures like Painted Medians, Centerline Gateway Treatment, and Intersection Tightening to reduce street widths only at certain points, LADOT should continuously reduce lane widths along the entirety of the Slow Street segment. Several streets are 40 feet wide with parking in both directions. Assuming that travel lanes can be reduced to 10 feet wide each[4] and the width of parking is 8 feet, this leaves space available for a 4-foot wide one-directional bike lane. Alternatively, a 2-foot buffer zone can be striped between the travel lane and parking in either direction of travel. Since some segments are even wider than 40 feet, the widths of either the bike lane or buffer zone may be adjusted depending on the width of the street. Nevertheless, either design could help decrease speeds by reducing the space available for vehicles.

Furthermore, it may be useful to reevaluate the criteria for countermeasure installation for their necessity. Since Slow Streets are meant to establish safe spaces for multimodal travel and outdoor recreation, significant restrictions on vehicle mobility may be needed as cars pose large safety risks to all other street users. However, if there are too many design constraints for the countermeasures, they may not be aggressive enough to have a meaningful impact on speeds and safety.

If certain criteria cannot be altered, LADOT could explore using other materials to work around the design constraint. For example, Painted Median bollards currently cannot be installed within 20 feet of fire hydrants as they may obstruct access to the hydrants by fire trucks. To relax this constraint, LADOT could explore using rubber curbs instead of bollards for the Painted Median countermeasure. Like bollards, rubber curbs horizontally divert traffic by introducing an obstacle on the street, but unlike bollards, emergency vehicles may easily drive over rubber curbs if needed.

Due to limitations in data availability and reliability in the StreetLight datasource, it may also be beneficial for LADOT to perform additional data collection through in-house speed surveys or contracting with a speed data collection service to confirm the findings of this report or to obtain more recent results. LADOT may also choose to collect volume and congestion data during peak and off-peak times and at Slow Street locations other than Koreatown KIWA to validate the finding that these variables were not linearly correlated with speed.

As previously mentioned, the increases in speeds on some segments may suggest flaws in the effectiveness of countermeasures at reducing speeds; however, this represents just one variable, and there are potentially other benefits of the countermeasures that were

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[4] The National Association of City Transportation Officials (NACTO) recommends 10-foot-wide lanes for urban areas for their safety benefits and negligible impact to traffic operations (NACTO, 2013).

not captured through a speed analysis. Supplemental analysis of collision data may reveal safety improvements induced by the countermeasures, particularly if there have been noticeable reductions in the number or severity of collisions.

This study performed a strictly quantitative analysis of speed changes using LBS and CVD data from StreetLight, but collecting qualitative data in a future study may provide a more holistic understanding of each countermeasure's effectiveness. For example, LADOT may learn about how drivers are interacting with the countermeasures through observing and documenting driver behaviors in the field. This information may be supplemented with resident interviews centered around *their* observations and opinions about the countermeasures that have the added benefit of gathering public input for future planning decisions.

Since only certain organizations may apply for Slow Streets, it is possible that many are unaware of where Slow Streets are located, even if they are near their place of residence. LADOT has created a map of all streets that are eligible to be converted into Slow Streets, but the agency does not have maps of the Phase 2 segments nor of the Slow Streets locations in general. Thus, it may be beneficial for the general public if LADOT were to create an interactive map with the current Slow Street network, including the Phase 2 segments, and share the link to the agency's website and social media accounts. LADOT may also consider collaborating with Google (or other map providers) to reinstate an overlay of established Slow Streets that used to exist on Google Maps, as shown in Figure 7. This would greatly improve accessibility to these streets.

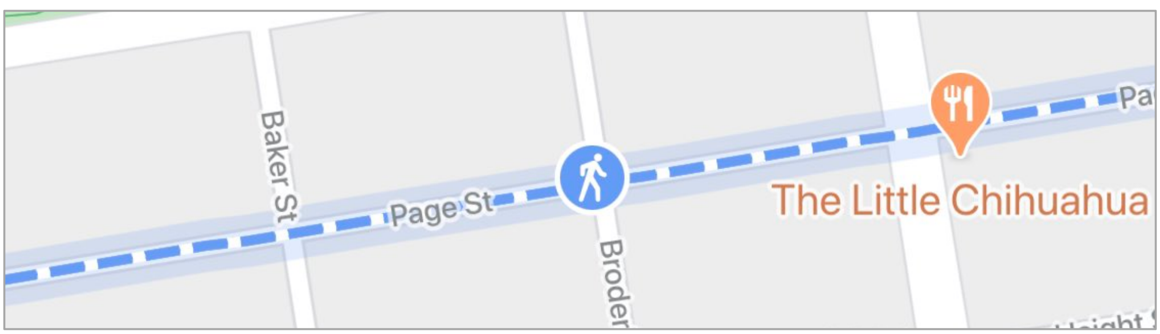

Figure 7: Google Maps Slow Streets overlay. Photo credit: Chris Arvin (@chrisarvinsf on Twitter) on May 18, 2020.

Conclusion

This study used StreetLight data and employed a formula comparing differences in average speed between street segments to estimate the effectiveness of each individual countermeasure at reducing speeds along Slow Streets. Treatments located at or near intersections led to the greatest estimated decrease in speeds. However, more importantly, the results showed that nearly half of all analyzed Slow Street segments experienced increases in average speed after the countermeasures were implemented. Additionally, all segments that experienced an increase in average speed had a greater proportion of speeds that exceeded LADOT's recommended speed of 15 MPH on Slow Streets.

This study was not a controlled experiment; therefore, it was difficult to pinpoint why speeds increased. However, we can speculate that three factors contributed to this trend: (1) the countermeasures have not caused large enough changes to the street geometry to affect driver behavior; (2) as traffic has returned to near pre-pandemic levels, drivers are using Slow Streets segments as "cut-through" routes; and (3) speeding has simply become more common on all streets (including Slow Streets) during and after the stay-at-home orders.

To improve the program, LADOT should consider prioritizing the installation of treatments positioned at intersections (such as Centerline Gateway Treatments, Traffic Circles, Signal Gateway Treatments, and Intersection Tightening) that provide the greatest estimated decrease in speed. To further decrease speeds, LADOT should also explore extending treatments that reduce lane widths to cover the entire street segment and using other materials to bypass design constraints that are restricting countermeasure installation. LADOT could also gather qualitative data and conduct interviews to obtain a more holistic view of the effectiveness of the program. Finally, LADOT should consider creating interactive maps of the Slow Streets network and the Phase 2 segments or collaborating with online map services to improve the public's access to Slow Streets.

Although this study suggests that Phase 2 has not been as successful as originally anticipated, there are plenty of opportunities for LADOT to turn things around. However, doing so may require LADOT to reevaluate whether their criteria for countermeasure installation are too restrictive, formulate ideas of how to relax design constraints, and commit to more aggressive changes to street geometry in order to foster the multimodal and recreational environment on Slow Streets that the agency envisions.

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Appendix

Appendix A: Criteria and Guidelines for Slow Street Designation

Criteria	Description
Street Type	Slow Streets are intended for residential Local and Collector Streets only as identified by the Mobility Plan Element of the General Plan of the City of Los Angeles. A map of eligible streets can be found at https://navigatela.lacity.org/slowstreets/.
Roadway Visibility	Midblock treatments should not be installed on street segments with severe vertical or horizontal curves.
Roadway Grade	LADOT engineers will take extra consideration on countermeasure design on street segments with a roadway grade greater than seven percent.
Number of Lanes	Slow Streets should only be installed on roads with one through lane in each direction. Designated Local and Collector streets with turning lanes may be eligible.
Street Use	Slow Streets should not be installed on designated truck or transit routes or on any street identified as a primary emergency route by any emergency response agency. Slow Streets shall not be installed immediately adjacent to a hospital, fire station, or police facility. The installation of Slow Streets adjacent to commercial uses should be avoided.
Physical Conditions	Traffic circles, centerline gateway treatments, and painted medians shall not be installed in front of driveways, over underground access covers, or obstruct drainage structures or catch basins.
Other Considerations	An engineering assessment of all pertinent safety factors will be made before making a determination on the installation of Slow Streets elements, which may include other considerations not mentioned in this table.

Appendix B: Treatment Toolkit Criteria and Considerations

Countermeasure	Criteria and Considerations
Centerline Gateway Treatment	● Entrances to Slow Street segments must be between 30 to 40 feet wide ● Red curb shall be installed where the striped lane width is less than 17 feet ● Bollards or signs shall not be installed within 20 feet of fire hydrants or within 11 feet of a driveway
Traffic Circles	● Traffic circles shall be installed at 4-way-stop-controlled intersections only ● Traffic circles shall be installed where one Slow Street segment crosses another Slow Street segment ● Feasibility of traffic circles varies based on geometrical alignments (e.g., skewed intersection legs, varying road widths, horizontal curves, small corner radii)
Painted Median	● Distance between intersections must be at least 600 feet ● Parking loss and approval from a professional engineer required for Slow Street segments that are between 30 to 40 feet wide ● Must not be installed along street segments that are less than 30 feet wide, on inclines, and along curves ● Painted median must be at least 4 feet wide, 10 feet long, and have 22 feet lines ● Ideally installed in the middle of the block ● Avoid driveways ● Bollards or signs shall not be installed within 20 feet of fire hydrants ● Red curb shall be installed where the striped lane width is less than 17 feet
Signal Gateway Treatment	● If street width is greater than 40 feet, consider installing in conjunction with the Intersection Tightening countermeasure ● Potential parking loss for street widths under 36 feet ● Red curb shall be installed where the striped lane width is less than 17 feet
Other Considerations	● Special consideration should be taken for first responder routes. These include streets where there is a police station within 2 blocks and Los Angeles Fire Department routes

Appendix C: Average Change in Speed Attributed to Each Countermeasure

Table A1: Signage & Street Markings

Street Segment	Change in Speed	
	1 Month After Installation	October - December 2022
Francis Ave	7	-2
Evergreen Ave	2	4
N St Andrews Pl	2	2
Santa Ana Blvd (comp. to 105th St)	-2	2
Santa Ana Blvd (comp. to 106th St)	0	0
Santa Ana Blvd (comp. to 107th St)	1	0
23rd St	-3	-4
25th St	-2	-3
Average	0.625	-0.125

Table A2: Centerline Gateway Treatment

Street Segment	Change in Speed	
	1 Month After Installation	October - December 2022
4th St	-1	-3
Lemon Grove Ave	2	1
Average	0.5	-1

Table A3: Traffic Circle

Street Segment	Change in Speed	
	1 Month After Installation	October - December 2022
Van Tress Ave	2	-3
New Hampshire Ave	-2.25	0.25
N Serrano Ave	-1.625	-1.875
Average	-0.625	-1.542

Table A4: Painted Median

Street Segment	Change in Speed	
	1 Month After Installation	October - December 2022
29th St	3	8
Coronado St	-0.5	2
Average	1.25	5

Table A5: Intersection Tightening

Street Segment	Change in Speed	
	1 Month After Installation	October - December 2022
Graham Ave (comp. to 105th St)	-0.75	0.5
Graham Ave (comp. to 106th St)	0.25	-0.5
Graham Ave (comp. to 107th St)	0.75	-0.5
Average	0.083	-0.167

Table A6: Signal Gateway Treatment

Street Segment	Change in Speed	
	1 Month After Installation	October - December 2022
Tabor St (comp. to Mentone Ave)	-4	1
Tabor St (comp. to Vinton Ave)	-5	1
Catalina St	2	-3
Hobart Blvd	-0.25	-1.25
Average	-1.813	-0.563