What’s in the Bike Lane?

A Study of the Factors Leading to Bike Lane Obstructions in Two Bay Area Cities

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Executive Summary

The purpose of this planning report is twofold. First, this report seeks to understand the factors that lead to obstruction of the bike lane. Second, this report aims to generate policy recommendations that cities can use to reduce potential obstructions in their bike lanes. This report focuses its analysis and recommendations on two study cities – Oakland and San José. These are both cities in the San Francisco Bay Area with ambitious bike plans and ambitious mode shift goals. It is the opinion of the author that maintaining free-flowing, unobstructed bikeways is essential to promoting the adoption of cycling as a mode of transportation – especially for the ‘interested but concerned’ cyclists that both cities aim to reach.

While there is significant literature on the perceived and actual safety of cyclists in specific types of bike lane infrastructure as well as the ability of bike lane infrastructure to influence mode choice, there is far less published research on obstructions in the bike lane. This report looks to help fill that gap by analyzing the causes of bike lane obstructions, looking for patterns as to where obstructions occur, and looking for ways to reduce obstructions. Cities are constantly dealing with competing interests in the public right-of-way and especially at the curb. Bike lanes, and specifically obstructions of those bike lanes are only one aspect of the roadway that cities must regulate. However, cycling mode share adoption – that is, more people choosing to bicycle for transportation – is crucial for cities to meet climate goals. Additionally, cyclists are among the most vulnerable road users – especially when compared to cars. Finding ways to improve the efficacy of a city’s bikeway network by adopting policies that limit obstructions is something that all cities should consider.

For this project, a mixed methods approach was taken. This report combines quantitative analysis of a unique data set with qualitative interviews conducted with planning staff at both study cities. The data for this report was collected in the field by the author. Additionally, obstructions were submitted directly to the author by other cyclists through an Instagram account (@whatsinthebikelaneoakland) that was created for this project. Just over one-fourth of Oakland obstructions were submitted through this account. Bike lane obstructions were recorded primarily on a series of defined routes in each study city. An attempt was made to balance as many lane-miles of Class II bike lanes and Class IV bikeways in both cities. Class II bike lanes are traditional paint-separated or buffered bike lanes. Class IV bikeways are protected, either parking separated, separated with quick build measures such as flexposts or jersey barriers, or separated with hardscaped concrete elements. Class I bikeways (fully separated from the right of way, such as an off-street trail) and Class III bikeways (designated bike routes or bike boulevards– streets without a protected or painted bike lane, but lower traffic streets with traffic calming measures for routes defined as bike boulevards) were not included in this project. Obstructions on these routes were either too hard to measure (Class III) or completely outside of the normal realm of what is expected (Class I).

Collection of data occurred primarily between April 2022 and August 2023. When riding along the prescribed routes, the author would pull over and photograph any observed obstructions. Upon ending data collection for that day, the author would return home and categorize each obstruction in a spreadsheet. This spreadsheet contained the locational coordinates of the obstruction obtained from the photograph metadata, as well as the day of the week, time, date, street, cross street, bike lane class, and type of obstruction.

Obstructions were categorized into three groups – systemic obstructions, willful obstructions, and chaotic obstructions. Typically, systemic obstructions occurred when a vehicle blocked the bike lane due to not having anywhere else to park. For this report, 'nowhere else to park' was defined as a situation where there was no legal parking space visible within a block. Systemic obstructions were typically delivery vehicles or work vehicles. Trash cans and dumpsters fell into this category as well, especially for those larger dumpsters that did not have a defined place in the street. Willful obstructions typically applied to privately owned vehicles whose drivers chose to park in the bike lane. Chaotic obstructions were often due to dumped objects or shared micromobility scooters in the bike lane.

After the data collection period ended, the spreadsheets were transferred to Esri ArcGIS Pro, where they could be analyzed in conjunction with existing data layers. These data layers include the location of specific bike lanes in both study cities, the base zoning type at the site of obstruction, and the borders of Equity Priority Communities as defined by the Metropolitan Transportation Commission (MTC) for Plan Bay Area 2050. The goal of this analysis was to determine whether specific types of bike lane classes were more frequently obstructed, whether obstructions occurred more or less frequently around different land uses, and if populations who were already disadvantaged were being subjected to an increased number of bike lane obstructions.

Analysis of the field collected data revealed several important findings. First, there were twice as many obstructions in Class II bike lanes compared to Class IV bikeways. This was true in both study cities, despite recording more obstructions in San José than Oakland. Additionally, this held true despite a disparity in existing Class IV bikeway mileage in the study cities.

Obstructions comprised of more than one object (multiple obstructions) were far more frequent in San José. These instances of multiple obstructions were usually related to garbage or recycling can obstructions, as well as due to unbundled yard waste.

The most common obstruction by type varied across both study cities. It also varied by bike lane class. In Oakland, obstructions due to parked or idling vehicles (police vehicles, delivery vehicles, work vehicles, and private vehicles) accounted for over three-quarters of all obstructions. This pattern was consistent across Class II and IV bike lanes – though parked vehicles were seen in Oakland's Class II bike lanes at much higher rates than Class IV bikeways (almost three to one).

In San José, the most common obstructor of the bike lane was garbage or recycling bins. These obstructions were also the most likely type to result in multiple obstructions. Garbage bin obstructions were often seen in conjunction with unbundled yard waste obstructions. This may be due to trash, recycling, and yard waste often being collected on the same day. Unbundled Yard Waste was an obstruction type unique to San José. Oakland requires residents to bundle their yard waste in paper bags or use provided green bins, like trash and recycling. Trash can and unbundled yard waste obstructions were more common in Class II bike lanes than Class IV bikeways.

Obstructions in Class IV bikeways, while less frequent, were often more likely to result in an impassable obstruction. An impassable obstruction is one that would likely force a rider to dismount their bike and walk on the sidewalk to pass the obstruction. Of the 72 obstructions recorded in Class IV bikeways across both study cities, 53 percent were deemed impassable based on a metric created for this study. Between the two study cities, this number was much higher in Oakland. 75 percent of Class IV obstructions in Oakland were deemed impassable.

Obstructions in Oakland were far more common in commercial zoning districts (n=56) than any other type of base zoning. The CN zoning type (Commercial Neighborhood Center) was the most common specific zoning in terms of obstructions (n=30). Residential uses were second (n=24) with the most obstructed residential specific zoning type being the RM (Residential Mixed Housing) zone (n=11).

In San José, Residential zoning was the most frequently obstructed. There was a strong pattern between the density of housing and the frequency of obstructions. Residential obstructions accounted for 85 out of 140 total obstructions (60.7 percent). As density increased, so did obstructions. There were 18 obstructions recorded in the R-1-8 zone (up to eight dwelling units per acre), 25 obstructions recorded in the R-2 zone (up to two dwelling units per lot), and 38 obstructions recorded in the R-M zone (multiple dwelling units per lot). 59 out of 85 (69.4 percent) obstructions in residential zones were due to garbage cans or unbundled yard waste.

Finally, this project looked at obstructions and their relation to MTC Equity Priority Communities (EPC), a composite indicator that measures concentrations of underserved population using demographic information such as race and income. When looking at cumulative obstructions across Oakland and San José, obstructions occurred more frequently in EPC census tracts than non-EPC census tracts. This was especially the case in San José, where 71.43 percent of recorded obstructions (n=100) were in EPC census tracts. Oakland's number was less strong, with 44.19 percent of obstructions (n=38) in EPC census tracts. Both cities have EPC tracts around their downtown and spread throughout the study areas. The study areas included as even of a mix of EPC and Non-EPC tracts as possible. Both study cities have similar amounts of EPC area despite a major difference in total area within their city limits.

In Oakland, 24.82 square miles of the City is within an EPC (31.82% of the total area). In San José, 24.67 square miles of the City is within an EPC (13.67% of the total area).

In conjunction with the data analysis, this project conducted interviews with planners at both study cities. The purpose of these interviews was to gain contextual information on the patterns discovered through data analysis and build a stronger case for specific policy recommendations. The following recommendations were shaped by information derived from the interviews.

Recommendations for both study cities:

-Build more Class IV protected bike lanes

-Consider using small, narrow sweepers to sweep protected bike lanes.

-Consider more permeable barriers when building protected bike lanes but scale them for objects smaller than a car.

-Consider adding a bollard at entrance points to Class IV bikeways.

-Build space for dumpsters into bikeway plans and use street infrastructure tools to create space for dumpsters and garbage cans on the street near existing bikeways.

-Create more flexible curb space in commercial areas with high frequency of deliveries.

-Educate the public on how protected bike lanes are supposed to work.

-Be creative. Design bikeways with site-specific information in mind and develop bikeway plans that allow for flexibility.

Recommendations for Oakland:

-Reconsider using parklets next to protected bike lanes or add very specific guidance and only permit parklets next to protected bike lanes in specific situations.

Recommendations for San José:

-Consider requiring yard waste to be bundled or set out in closed receptacles. End the free unbundled yard waste option for residents.

-Consider revising garbage set-out rules to allow for more flexibility as to where cans are initially placed by residents. Additionally, look to increase on-site pickup in areas with higher density housing.

-Consider using lock-to requirements for shared micromobility devices (scooters) in targeted areas of San José.

Obstructions in the bike lane are only one factor that may prevent someone from riding a bike as opposed to driving. There are greater, more common safety implications – primarily interactions between cyclists and motor vehicles. The evidence shows, however, that there are policies that cities could enact, and tactics cities could follow that would likely reduce the number of obstructions in their bike lanes. Policies designed to reduce obstructions may be easier to utilize and implement than policies that are designed to make drivers slow down. Certainly, these strategies should be implemented simultaneously. Slowing down car travel speeds on city streets is crucial to making the “interested but concerned” potential ridership group referred to in both study cities’ bike plans feel more comfortable riding their bikes on the street.

The findings and recommendations of this study provide a pathway that cities can follow to reduce bike lane obstructions. As time passes and the target years for city mode shift goals approach, it will remain to be seen whether cities truly embrace the necessary policies to encourage people to adopt alternative modes of transportation. Continuing to allocate space for private vehicles in the public right-of-way at the level that cities currently follow is not a strategy that will work into the future. Space must be reallocated and properly managed to create safe and reliable transportation options that will help cities reach their mode shift goals.

Figure ES.1: Class I Bike Path (Three Creeks Trail) in San José.
Source: City of San José

Figure ES.2: Buffered Class II Bike Lane on Broadway in Oakland.
Source: City of Oakland

Figure ES.3: Class III Bike Route with sharrow and traffic diverter on 55th Street in Oakland.

Figure ES.4: Class IV Protected Bikeway on San Fernando Street in San José.

The following report examines the conditions of bicycle infrastructure in two cities in the San Francisco Bay Area – Oakland and San José. More specifically, this report focuses on how bicycle infrastructure is obstructed and the impact of those obstructions on bicycle safety, rider experience, and impacts on mode shift goals. For numerous reasons including exercise potential, climate change mindfulness[1], or due to its relative affordability as a mode of transportation[2], cycling in an urban or suburban environment has increased over the last two decades.

A common use case for bicycling within the urban environment is commuting to work. San Francisco (the metropolitan area in which Oakland is situated) and San José are two of the top three metropolitan areas in the United States with the highest rates of bicycle commuting, at 2.0 percent and 1.82 percent, respectively.[3] As more people use bicycles as a form of urban transportation, cities have responded by developing bicycle specific infrastructure to increase bicycle mode split. Studies show that bike lanes – and especially protected bike lanes, which are separated from car traffic by a physical barrier – increase both the perceived[4] and actual safety[5] of cyclists. Additionally, studies point to the presence of a bike lane as having a significant impact on whether people choose to bicycle or not.[6]

While there is significant research into the effect of bike lanes on cycling safety and cycling mode choice, there is much less research into what happens when the bike lane is obstructed. The cost of bike lane installation varies, with a Federal Highway Administration manual citing a cost of up to $50,000 per mile.[7] Another study from the Pedestrian Bicycle and Information Center (which is funded by the U.S. Department of Transportation) cites a median bicycle lane construction cost of just under $90,000 per mile, noting that this can vary by location.[8] Given the significant municipal expenditures on bike lane expansion, seeing these exclusive rights-of-way regularly obstructed by parked vehicles or stationary objects is both an inefficient use of limited tax dollars as well as a safety risk for cyclists who are forced to maneuver around the obstructions.

1. Jeroen Johan de Hartog, et al. “Do the health benefits of cycling outweigh the risks?” *Environmental Health Perspectives* vol. 118, no. 8 (2010): 1109-16. https://doi.org/10.1289/ehp.0901747
2. S.L. Handy, Xing, Y. & Buehler, T.J. “Factors associated with bicycle ownership and use: a study of six small U.S. cities.” *Transportation* 37, 967–985 (2010). https://doi.org/10.1007/s11116-010-9269-x
3. Justin Tyndall. “Cycling mode choice amongst US commuters: The role of climate and topography.” *Urban Studies*, 59(1), (2022): 97–119. https://doi.org/10.1177/0042098020957583
4. McNeil, Nathan, Christopher Monsere, and Jennifer Dill. “Influence of Bike Lane Buffer Types on Perceived Comfort and Safety of Bicyclists and Potential Bicyclists.” *Transportation Research Record* 2520, No. 1 (2015): 132 142, https://doi.org/10.3141/2520-15
5. Jessica Cicchino, et al. “Not all protected bike lanes are the same: Infrastructure and risk of cyclist collisions and falls leading to emergency department visits in three U.S. cities.” *Accident Analysis & Prevention* 141 (2020): 105490, https://doi.org/10.1016/j.aap.2020.105490
6. Kevin Manaugh, Geneviève Boisjoly, and Ahmed El-Geneidy. “Overcoming barriers to cycling: Understanding frequency of cycling in a university setting and the factors preventing commuters from cycling on a regular basis.” *Transportation* 44, No. 4 (2017): 871-884, http://doi.org/10.1007/s11116-016-9682-x
7. “Road Design: Adding Bicycle Lanes”, Federal Highway Administration, n.d., Accessed May 6th, 2023. https://safety.fhwa.dot.gov/saferjourney1/library/countermeasures/10.htm
8. Max Bushell, et al. “Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public.” July 2013. https://www.pedbikeinfo.org/cms/downloads/Countermeasure_Costs_Summary_Oct2013.pdf

Both Oakland and San José have ambitious mode split goals. By the year 2050, Oakland's *Equitable Climate Action Plan*[9] aims for a 10 percent bicycle mode split, and San José's *Better Bike Plan 2025* hopes to achieve a 20 percent bicycle mode split.[10] It is the belief of the author that maintaining a free-flowing bikeway clear of obstructions is a key factor towards achieving these lofty mode split goals.

Several studies from New York have recorded and categorized bike lane obstructions. Both studies found that obstructions were common occurrences in both protected and non-protected bike lanes[11] and that obstructions pose a safety risk to cyclists.[12] This report aims to categorize the types of bike lane obstructions that occur in both Oakland and San José, and to analyze the most common factors that lead to bike lane obstructions.

9. City of Oakland, *Equitable Climate Action Plan*, July 2020. Accessed May 6, 2023, https://www.oaklandca.gov/projects/2030eca
10. City of San José, *Better Bike Plan 2025*, October 2020. Accessed May 6, 2023, https://www.sanJoséca.gov/home/showpublisheddocument/68962/637477999451470000
11. Peter Tuckel and Kate Pok-Carabalona. "Bike Lanes or Blocked Lanes: An Observational Study of Obstructions of New York City's Bike Lanes." (2019), https://hunter.cuny.edu/news/hunter-college-study-finds-7-5-obstructions-per-10-city-blocks/
12. Corey Basch, Danna Ethan, and Charles Basch. "Bike Lane Obstructions in Manhattan, New York City: Implications for Bicyclist Safety." *Journal of Community Health*, 44, No. 2 (2019): 396–399, https://doi.org/10.1007/s10900-018-00596-4

ECAP Mode Shift Targets from CURB Analysis

Travel Modes	On Road	Today	2030 Deep Decarbonization	2050 Deep Decarbonization
Private Autos & Trucks	Yes	69.1%	40.0%	20.0%
Motor Cycle	Yes	1.6%	1.6%	1.6%
Taxi/TNC 1 or 2 pass.	Yes	1.6%	3.0%	3.0%
TNC Pooled Ride	Yes	Not avail.	5.0%	5.0%
Shared Minibus	Yes	Not avail.	9.0%	10.0%
Standard Bus/BRT	Yes	11.9%	15.0%	19.9%
BART	No	6.5%	8.0%	14.0%
Amtrak	No	1%	3.0%	3.0%
Ferryboat	No	0.1%	0.4%	1.0%
Biking	No	3.3%	7.5%	10.0%
Walking	No	4.9%	7.5%	12.5%

Figure 1.1: Mode shift targets from Oakland's Equitable Climate Action Plan

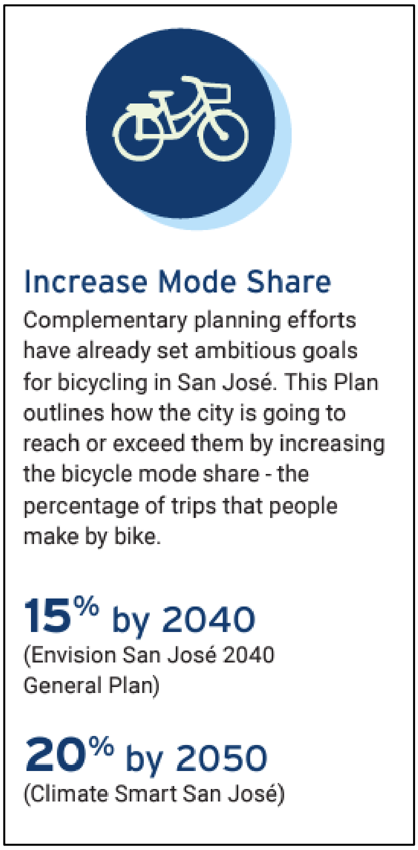

Figure 1.2: Mode shift targets from San José's Better Bike Plan 2025.

Existing Bicycling Conditions in Oakland

The city of Oakland, California is in Alameda County, just five miles east of San Francisco in the heart of the San Francisco Bay Area. Oakland's population is 433,823 and it has a land area of 55.93 square miles[13], giving Oakland a population density of 7,756 residents per square mile. Oakland is bordered by the cities of Berkeley and Emeryville to the north and northwest, the City of San Leandro to the southeast, San Francisco Bay to the south and west, and the Oakland Hills to the east. While much of Oakland is relatively flat, there is a gradual incline in an eastbound direction; the highest point in the hills, Vollmer Peak, has an elevation of 1,905 feet.

Though elevation changes and uphill roads can pose a challenge to cyclists, Oakland has built an extensive bikeway network. Studies show that hills may not actually be a statistically significant barrier to cycling adoption.[14] To that end, hilly terrain was not cited as a barrier to cycling in the survey within Oakland's bike plan, *Let's Bike Oakland.*[15] In California, there are four classifications of bike lanes or bikeways – numbered one through four. Class I bikeways are off-street bike paths, often multi-use and fully outside of the vehicle right of way. Class II bike lanes are the most common and recognizable type – these are traditional, on-street painted bike lanes, separated from motor traffic with striping only. Class III bikeways are either bike routes or bike boulevards. These are on-street bikeways, not separated from traffic with striping or a barrier, but located on low-traffic, low-stress roads designed to create a safer cycling environment. Bike boulevards are not synonymous with bike routes – they feature specific traffic calming measure sand are required to meet speed and traffic volume standards. Class IV bikeways are on-street, protected bike lanes – separated from motor traffic with either a hardscaped barrier or quick-build treatments such as plastic bollards or flexposts.

Between 2007 and 2019, the city increased its bikeway network from 104 miles to 164 miles.[16] As of 2019, only one mile of the existing bikeway network was a Class IV bikeway. The proposed bikeway network in the *Let's Bike Oakland* plan includes 219 additional miles of new and upgraded bikeways – upgraded meaning that the bikeway would receive a higher level of protection from motor traffic.[17] This increase in bikeway miles coincides with a significant number of Oakland residents who express a desire to ride their bike more than they currently do. Six districts in the flatlands and lower hills of Oakland were surveyed and on average, just under 66 percent of residents would like to ride more.[18] This same survey highlighted that bike stress is a major issue in Oakland, with aggressive drivers being the most common reason people choose not to bike.[19]

13. United States Census Bureau, "QuickFacts: Oakland city, California", n.d. Accessed May 6, 2023, https://www.census.gov/quickfacts/oaklandcitycalifornia
14. Tyndall, 2022.
15. City of Oakland, *Let's Bike Oakland*, accessed May 6, 2023. https://www.oaklandca.gov/resources/bicycle-plan
16. *Let's Bike Oakland*, 39
17. *Let's Bike Oakland*, 95
18. *Let's Bike Oakland*, 25
19. *Let's Bike Oakland*, 26

Let's Bike Oakland is heavily focus on creating low-stress, neighborhood bike routes that allow people to ride on non-arterial, quiet streets that feature traffic calming measures and low traffic levels.[20] According to the Transportation Injury mapping System (TIMS), there were 349 total bike crashes in Oakland between 2020 and 2022, with three fatalities and 31 severe injuries.[21] TIMS data is likely underreported as it only contains officially reported crashes through the California Statewide Integrated Traffic Records System (SWITRS) – without a police report, a bike crash does not make it into TIMS. 77 percent of severe and fatal bicycle crashes in Oakland during 2018 occurred on just three percent of the city's roadway network[22] – these "high injury corridors" are often major arterials. Oakland is no longer proposing any sort of arterial bike route that forces cyclists to share a lane with drivers on these busy streets and looking to build protected bike lanes or low-stress routes to move cyclists away from the danger.[23]

20. *Let's Bike Oakland*, 82
21. University of California, Berkeley, *Transportation Injury Mapping System*. Accessed May 6, 2023. https://tims.berkeley.edu/tools/query
22. *Let's Bike Oakland*, 38
23. *Let's Bike Oakland*, 22.

Figure 1.3: Protected Cycle track on Lakeside Drive in Oakland. Source: Bike East Bay

Existing Bicycling Conditions in San José

The city of San José, California is in Santa Clara County, about 50 miles south of San Francisco. San José is the 11th largest city in the United States, with a population of 971,233 and a land area of 178.26 square miles.[24] With a population density of 5,684 residents per square mile, San José is easily characterized as a sprawling city – it is the fourth largest city in California in terms of total area. Located in the Santa Clara Valley, San José is bordered by mountain ranges on both its west and east ends. Mt. Hamilton is the highest point in the Diablo Range to the east, and Loma Prieta is the highest point in the Santa Cruz Mountains to the west. San José has very non-standard city limits due to rapid expansion and annexation of nearby municipalities in the mid-20th century. This puzzle-like border gives San José many neighbors. It is bordered by the city of Milpitas to the north, the cities of Santa Clara, Cupertino, Saratoga, and Campbell to the west, the town of Los Gatos to the southwest, and the City of Morgan Hill to the southeast. While there are significant elevations at the far ends of the city limits, a large majority of the heavily inhabited parts of San José are entirely flat. This mostly-flat terrain helps to create a fertile environment for cycling. Unfortunately, the distances that people are often required to travel by bike are quite lengthy due to San José's sprawling size – 61 percent of residents polled for San José's Better Bike Plan 2025 cited long distances as a barrier to cycling.[25]

San José has constructed an extensive bicycle network to help bridge the long distances between places that residents might need to ride. Starting in the 1970s when the first bike lanes were striped in San José, the city has constructed a total of 460 miles of on-street bikeways and 63 miles of multi-use off-street paths.[26] The Better Bike Plan includes recommendations to build 102 miles of bike boulevards (Class III), 104 miles of new protected bike lanes (Class IV), and 253 miles of upgrades of existing bike lanes to protected ones.[27] Like Oakland, San José is focusing on building low-stress bike routes – the Better Bike Plan only calls for the construction of protected bike lanes and bike boulevards, following their own surveys and existing research which points to these as the safest options and the options likely to incur the highest levels of mode shift.[28] 55 percent of residents surveyed for the Better Bike Plan say that they would like to ride a bike more, with the highest rates of cycling demand in the four most centrally located city council districts.[29] In the period between 2020 and 2022, TIMS recorded 586 bike crashes in the City of San José, with seven fatalities and 48 severe injuries[30].

24. United States Census Bureau, "QuickFacts: San José city, California", n.d. Accessed December 4th, 2023, https://www.census.gov/quickfacts/fact/table/sanJosécitycalifornia
25. *Better Bike Plan*, 32.
26. City of San José, "Bike Plan and Trail Network – Annual Update", April 3rd, 2023. Accessed December 2nd, 2023, https://sanJosé.legistar.com/View.ashx?M=F&ID=11807821&GUID=825E276C-43FD-438E-8DD5-D88A7DDF8A6C
27. *Better Bike Plan*, 65.
28. *Better Bike Plan*, 52, 55.
29. *Better Bike Plan*, 31.
30. *Transportation Injury Mapping System* data query.

Like Oakland, San José has identified "priority safety corridors" – the streets that account for an outsized proportion of roadway fatalities and severe injuries. In San José, three percent of streets account for over one-third of all fatalities and severe injuries.[31] The response of the bike plan is to encourage cycling on less busy routes and create protected bike infrastructure on these busy streets that carry higher loads of bicycle and car traffic.

Research Question

What are the factors that lead to obstruction of the bike lane in Oakland and in San José? What kind of policy suggestions can be generated from the findings, and how can cities more proactively manage space at the curb to limit obstructions and promote a free-flowing bicycle network?

Relevance of the Research Question

The following report aims to understand the factors that lead to obstruction of the bike lane in both Oakland and San José. A major focus of transportation planning initiatives over the past decade has been the effort to reduce greenhouse gas (GHG) emissions by promoting modes of transportation other than gas-powered cars. Transportation accounted for the largest percentage of GHG emissions by sector in California between 2000 and 2020 – 38 percent.[32] The United States Environmental Protection Agency (EPA) proposed three distinct routes towards reducing GHG emissions in the transportation sector – one of which is to shift the modes of transportation people use from automobiles with internal combustion engines to zero emission vehicles – such as bicycles.[33]

To accelerate this necessary mode shift away from driving, cities have invested heavily in bicycle infrastructure to create a safe environment for urban cyclists. Safety is consistently cited as one of the primary barriers to widespread bicycle use amongst people who live in urban areas.[34] In the United States, development of urban road networks in the 20th century was heavily focused on maximizing vehicle throughput[35] – that is, getting as many cars from one place to another, as efficiently as possible. Planning to maximize vehicle speed had obvious negative effects on the street environment from a cycling perspective. High speed travel lanes designed to get cars onto freeways does little to promote a safe environment for cycling. Trying to incentivize a mode shift towards cycling in places primarily designed for car travel requires the development of bicycle infrastructure that protects cyclists from drivers.

31. *Better Bike Plan*, 34.
32. California Air Resources Board, "Current California GHG Emission Inventory Data," accessed May 9th, 2023, https://ww2.arb.ca.gov/ghg-inventory-data
33. United States Environmental Protection Agency, "Routes to Lower Greenhouse Gas Emissions Transportation Future," accessed May 9th, 2023, https://www.epa.gov/greenvehicles/routes-lower-greenhouse-gas-emissions-transportation-future
34. Manaugh, 2017.
35. Jeffrey R. Brown, Eric A. Morris, and Brian D. Taylor. "Planning for Cars in Cities: Planners, Engineers, and Freeways in the 20th Century." *Journal of the American Planning Association* 75, no. 2 (Spring, 2009): 161-177. https://doi.org/10.1080/019443608026400

While separated bike lanes have existed in the United States as far back as the 1970s[36], early guidance on bike lane placement strongly opposed 'parking-separated' bike lanes – where bicycle traffic is routed between parked cars and the sidewalk and strongly suggested that "bicycle lanes should always be placed between the parking lane and the motor vehicle lanes."[37] Three to four decades later, the consensus on the safest place for a bike lane has shifted, and cities studied in this report – Oakland and San José – have adjusted the focus of their bicycle planning towards developing protected bike lanes.

Research shows that physical separation from drivers as opposed to a painted line or buffer leads to significant increases in perceived cyclist safety.[38] [39] Additionally, research shows that off-street bike trails (fully removed from the right of way) (Class I) and protected bike lanes (Class IV) lead to an increase in bicycling.[40] Both Oakland and San José are focused on developing a network of low-stress bike routes in their most current respective bicycle plans. Both cities are focusing on building new protected (Class IV) bikeways as well as upgrading their existing Class II bike lanes to Class IV status.[41] [42]

While the increased focus on the development of low stress, protected bikeways for urban cyclists is an essential part of the equation towards generating a mode shift to cycling, it is not a standalone solution. The design, approval and construction of protected bikeways is a key first step towards accelerating mode shift in a manner that prioritized safety. Ensuring that these new bikeways remain free from obstructions is critical to cementing this mode shift and preventing 'interested but concerned' cyclists from becoming discouraged. Cities which have historically relied on cars as the primary mode of transportation – especially sprawling cities like San José – means that it is easy for a discouraged cyclist to revert to using a car when faced with a series of unpleasant bicycling experiences. Studies show that bike lane obstructions are commonplace, even in protected bike lanes – and that they do pose a risk to rider safety.[43]

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36. William Schultheiss, Rebecca Sanders, and Jennifer Toole, "A Historical Perspective on the AASHTO Guide for the Development of Bicycle Facilities 2 and the Impact of the Vehicular Cycling Movement," *Transportation Research Record*, 2672(13), 38–49. https://doi.org/10.1177/0361198118798482
37. Schultheiss, Sanders, and Toole, 10.
38. Nathan McNeil, Christopher Monsere, and Jennifer Dill, "Influence of Bike Lane Buffer Types on Perceived Comfort and Safety of Bicyclists and Potential Bicyclists," *Transportation Research Record* 2520 no.1, (2015): 132–142. https://doi.org/10.3141/2520-15
39. Xiang Guo, et al., "Psycho-physiological measures on a bicycle simulator in immersive virtual environments: how protected/curbside bike lanes may improve perceived safety," *Transportation Research Part F: Psychology and Behaviour* 92, (2023): 317–336.
40. Michael Garber, et al., "Have Paved Trails and Protected Bike Lanes Led to More Bicycling in Atlanta? A Generalized Synthetic-Control Analysis," *Epidemiology* 33 no. 4, (2022): 493-504, https://doi.org/10.1097/EDE.0000000000001483
41. *Let's Bike Oakland*, 80.
42. *Better Bike Plan 2025*, 62-65.
43. Basch, Ethan, Basch,

Creating and maintaining the flow of bicycle traffic through this low-stress network is essential to cementing mode share goals. San José aims to increase bike mode share to 15 percent by 2040 and 20 percent by 2050[44], and this won't happen if the experience is consistently frustrating, or cyclists are routinely forced to abandon safe infrastructure to maneuver around an obstacle.

What causes the bike lane to be obstructed? Do bike lane obstructions occur due to street design issues? Many of our roadways were developed in a bygone era, where uses of the public right-of-way differ heavily from today. Transportation planners working in the 1950s and 1960s could not have foreseen the quantity of freight vehicles and app-based rideshare and delivery service vehicles which have proliferated in recent years, especially since the onset of the COVID-19 pandemic. What new, creative ways of managing curb space can be implemented to account for these vehicles that often block the bike lane because they have nowhere else to be? Are some bike lane obstructions caused by willful neglect of the right-of-way, such as private cars idling or parking or the dumping of unwanted goods? Is the bike lane ever obstructed purely by accident? Are there structural issues with the way cities manage the curb that can lead to obstructions of the bike lane, such as refuse service and yard waste? Obstructions of the bike lane are often in areas where bike infrastructure is underdeveloped[45], but what happens when protected bike lanes are blocked? How do riders negotiate obstructed bike lanes when there is no easy way around an obstruction?

44. *Better Bike Plan 2025*, 9
45. Marcel Moran, "Eyes on the Bike Lane: Crowdsourced Traffic Violations and Bicycle Infrastructure in San Francisco, CA." *Transport Findings*, April 2020. https://doi.org/10.32866/001c.12651.

Literature Review

Introduction

The purpose of this literature review is to explore the current literature and research on bikeway obstructions. In addition to literature specifically related to obstructions and conflicts in the bike lane, this review examines literature related to whether different types of infrastructure impact perceived and actual cyclist safety. While there is much existing literature about municipal investments in expanded and safer bikeway networks to encourage mode shift, there is a lack of scholarly research on municipal programs designed to cement mode shifts through efforts to maintain a free-flowing, unblocked bikeway. This review examines the existing literature on both municipal and informal, citizen-driven projects to prevent and report bikeway obstructions. Finally, this review will examine how cities are attempting to allocate space at the curb in more flexible ways than simple on-street parking to reduce obstructions.

The literature review to follow will be broken up into two sections. The first section will examine the literature on the three topics outlined above. To reiterate, those topics in question form are as follows:

- Do different types of bikeway infrastructure impact rider safety (perceived or actual) or mode choice frequency?
- Are there existing cases of municipal projects to prevent obstructions of the bike lane? Or are existing efforts individual or community-driven?
- What examples exist of innovative curb management strategies that create additional flexibility and/or new methods of space allocation?

The second section will aim to summarize what was learned through the analysis and propose ideas for future research. At the end of this report, Appendix C will contain a list of search terms and catalogs used to complete the literature search for this review.

Analysis of Literature Review Questions

The following literature review is split into three subsections, each dealing with one specific question. There was only a small amount of literature specifically regarding obstructions in the bikeway, so the scope of the literature review was expanded to include additional topics that focus on the impacts of bikeway hazards, existing systems for reporting or preventing them, and potential future methods to reduce bikeway friction between cyclists and their surrounding environment. These topics were selected to provide a well-rounded approach to understanding the inputs that may create bikeway obstructions as well as the outputs that stem from these obstructions. A full list of search terms, journals, databases used, and keywords is presented in Appendix C.

The articles included in this review focus on studies within urbanized areas, predominantly within the United States and Canada. Of the articles included in this review (n=20), 17 of them had one or more focus areas. The other three either utilized a virtual environment or reviewed existing literature. Of the 17 articles with focus areas, 11 were in the United States, three were in Canada, two were in Germany, and one was in Australia. Of the 11 American cities, New York City was the most common study area (n=5).

The goal of this review is to characterize the impact that obstructions can have on cyclist safety and highlight the importance of maintaining a free-flowing bicycle network to retain mode share in the long term.

Impacts of bikeway infrastructure on safety and mode choice

The first section analyzes existing literature on the impact of different types of bikeway infrastructure on rider safety and mode choice. There was no shortage of literature on the topic of cyclist safety and bikeway infrastructure, including a few articles that dealt specifically with obstructions as a safety hazard. While the methods used by the researchers varied, there was a general agreement that types of bikeway infrastructure impact both the perceived safety of cyclists as well as their actual safety.

The most common finding across all the studies analyzed for this question was the positive impact of separated, protected bikeways on rider safety and mode choice. The literature shows that cyclists feel safer when there is a physical barrier between them and auto traffic. This was measured through surveys, virtual and video reviews, and on-road observations. Measurements from an immersive virtual environment in a study conducted by Guo et al., displayed a higher safety rating in protected lanes in several ways. Study participants in the virtual environment maintained a greater focus on the roadway in a virtual protected bike lane as opposed to a virtual painted lane, participants maintained lower heart rates, steadier and slower overall speeds, and stayed furthest from the virtual cars.[46] Cyclists in this study gave the highest post-test ratings to the virtual protected lanes. This is corroborated in a study by Monsere, McNeil, and Sanders, where cyclists reviewed first-person video clips of bicycle interactions at street intersections and rated the protected situations as feeling the safest.[47] Knight and Charlton used a similar video review to Monsere, McNeil, and Sanders, but supplemented their observations from the video review with an on-road test.[48] Knight and Charlton's respondents rated the protected lanes highest in both the video and on-road tests. Participants in this study stated that they would be more willing to allow their children to ride in protected lanes than non-protected lanes, which points to additional mode share benefits of protected bikeway infrastructure.[49]

46. Guo, et al.
47. Christopher Monsere, Nathan McNeil, and Rebecca Sanders, "User-Rated Comfort and Preference of Separated Bike Lane Intersection Designs." Transportation Research Record 2674, No. 9 (2020): 216-229, https://doi.org/10.1177/0361198120927694
48. Alexandra Knight and Samuel Charlton, "Protected and unprotected cycle lanes' effects on cyclists' behaviour." Accident Analysis & Prevention 171 (2022): 106668, https://doi.org/10.1016/j.aap.2022.106668
49. Knight and Charlton 5.

Knight and Charlton's study paralleled Guo et al. in their measurement of cyclist head movement. Using simple counts (Knight and Charlton) or advanced eye trackers (Guo et al.), cyclists in protected lanes can concentrate on the ride rather than constantly scanning the cars that are passing them.

On-road and in-field observations generated additional data to support protected bikeways (and bikeway infrastructure in general) as having a positive impact on rider safety and mode choice, though not exclusively so. A research study by Tuckel and Pok-Carabalona categorized bikeway obstructions and ridership in both protected and non-protected bike lanes in New York City; they found a 4.5 to one usage rate in favor of the protected bikeways.[50]

Another study in New York by Conway et al. directly observed a lower rate of bikeway conflicts in protected lanes as opposed to unprotected lanes.[51] This assertion was contradicted by a more recent New York City study from Basch, Ethan, and Basch, which also used a field observation method and characterized obstructions in protected bikeways as common occurrences that impact rider safety.[52] This study noted that obstructions in protected bikeways were identified at all their study test sites, without certain neighborhood characteristics leading to a lack of obstructions.[53] The Tuckel and Pok-Carabalona study also spoke to the variation in the types of hazards present in protected bikeways. This study found it more common to see pedestrian/bike conflicts and active transportation conflicts in protected bikeways as opposed to automobile conflicts (both parked and moving), which were more common in unprotected bikeways.[54]

Finally, several of the studies in this review used surveys as a method to gather data regarding the impacts of bikeway infrastructure on rider safety. The prevalence of and demand for protected bikeways is a slightly newer phenomenon in North America. The study by Manaugh, Boisjoly, and El-Geneidy from Montreal showed that the presence of any bikeway infrastructure was a major factor on whether people would choose to bicycle or not.[55] Additionally, this study highlighted the 'latent demand' for cycling, with 75 percent of "rarely" and "usual" cyclists (the middle groups between "never" and "always") expressing a desire to ride more often.[56] The researchers cite this latent demand in these intermediate groups (often referred to in the United States as the "interested but concerned" group) as their motivation for studying the barriers to cycling in order to effect mode shift.[57] This same concept motivates my own research to study the causes and impacts of bikeway obstructions from a similar mindset. A study by Cicchino et al. directly surveyed patients in hospital emergency departments who were involved in bicycle crashes.

50. Tuckel and Pok-Carabalona.
51. Alison Conway, et al., "Characteristics of Multimodal Conflicts in Urban On-Street Bicycle Lanes." Transportation Research Record 2387, No. 1 (2013): 93-101, https://doi.org/10.3141/2387-11
52. Basch, Ethan, Basch.
53. Basch, Ethan, Basch, 398.
54. Tuckel and Pok-Carabalona, 10.
55. Manaugh, Boisjoly, and El-Geneidy.
56. Manaugh, Boisjoly, and El-Geneidy, 7.
57. Manaugh, Boisjoly, and El-Geneidy., 14.

This study found that the risks of crashing or falling can vary on different types of bikeway infrastructure – with the lowest risk seen on heavily separated bikeways with few intersections or cyclist/car interaction points.[58]

Surveys from a study by McNeil, Monsere, and Dill across five American cities showed that extra buffered space in bike lane infrastructure can increase the perceived safety of current and potential bicyclists, and that vertical separation of some sort (compared to just paint) makes a positive difference in comfort levels, especially for the "interested but concerned" group.[59] This focus on additional space dovetails with a literature review by Schimek that examines car doors and bikeways - additional space buffered in can increase actual cyclist safety by permitting enough room for cyclists to remain in the bikeway when faced with a car door obstruction.[60] This issue of lane space applies to both bike lanes as per Schimek and commercial vehicle parking lanes, as in the study by Butrina et al. in which they evaluated the effectivity of Commercial Vehicle Loading Zones (CVLZs) in Seattle, Washington.

The Butrina study found in part that the narrow width of CVLZs in Seattle forced cyclists into traffic even when freight vehicles were legally parked, as the typical freight vehicle was too wide for the existing space.[61] This effect was multiplied by the speeds at which these incidents can happen due to the topography of Seattle and bike/freight interactions often happening on or near the bottom of a hill.[62] Finally, a survey completed by the Bicycle Council of Greater Philadelphia (cited in a thesis by Montgomery) pointed to the issue of space often forcing Philadelphia cyclists onto the sidewalk, which creates obstructions for pedestrians. As the width of the bikeway increased, the percentage of cyclists on the sidewalk decreased.[63] This survey was completed prior to the construction of any protected bikeways in Philadelphia, but the widest lane cited in the survey (a buffered bike lane) had a corresponding sidewalk riding rate of only three percent.[64]

While most articles cited in this review spoke positively about protected bikeways and bikeways with increased space for cyclists, not every study agreed on this viewpoint. A study by Basch, Ethan, and Basch is one of the few to characterize bikeway obstructions as impacting rider safety. Their in-field observations of bike lane obstructions in Manhattan showed that obstructions were common in protected bike lanes, and crashes in these lanes were still an issue. The researchers observed 233 obstructions in protected bikeways in Manhattan in Fall 2018 alone.[65]

58. Cicchino, et al.
59. McNeil, Monsere, Dill.
60. Paul Schimek, "Bike lanes next to on-street parallel parking." Accident Analysis and Prevention, 120 (2018): 74-82, http://doi.org/10.1016/j.aap.2018.08.002
61. Pacific Northwest Transportation Consortium (PacTrans), Seattle Department of Transportation (SDOT), and University of Washington, An Evaluation of Bicycle Safety Impacts of Seattle's Commercial Vehicle Loading Zones, by Polina Butrina, et al. (Seattle, 2016).
62. Butrina et al., 18.
63. Douglas Montgomery, "Philly Bike Report: A Mobile App for Mapping and Sharing Real-Time Reports of Illegally Blocked Bike Lanes in Philadelphia" (master's thesis, University of Southern California, 2017), ProQuest Dissertations Publishing.
64. Montgomery 10.
65. Basch, Ethan, Basch 397.

Similarly, while the Tuckel and Pok-Carabalona study had positive things to say about protected bikeways increasing ridership, their outlook on obstructions in these bikeways was less positive - they found that specific types of obstructions (pedestrians, dogs, scooters, and other bikes) were far more common in protected bikeways than painted ones.[66] Cicchino's survey of hospitalized cyclists supports this assertion. Her research found that lightly separated bikeways can reduce cyclist/car crashes, but these are sometimes replaced with bike/pedestrian crashes – more robust protection is important to keep cyclists safe.[67]

A hallmark of the strongest studies in this review was the researchers' collection of their own data. Whether observational data collected in the field or survey data obtained in person or through the mail, the studies that had the strongest findings collected their own data. Both studies by Kirschner and McNeil, Monsere, and Dill used a mail survey to collect data on perceived cyclist safety. To further enrich their responses by ensuring that their respondents were active cyclists as opposed to simply living in a defined area, McNeil, Monsere, and Dill added an intercept survey to their study. This secondary survey, which was handed out to cyclists at red lights allowed the researchers to reach a group of respondents who were certain to be cyclists.[68] This helps to ensure that survey responses were coming from people with experience in urban cycling environments. Additionally, this helps counteract the potential effects of a relatively homogenous neighborhood population on survey results, which was cited as a limitation of the McNeil study[69]. Studies that used existing datasets, such as Garber et al.'s study of Strava (a social network of cyclists sharing their rides) data in the Atlanta area were less effective.

This study estimated that a paved, off-street trail had a positive impact on cycling use but could not make that same statement about on-street protected bike lanes.[70] While the data in these sorts of analyses are technically accurate, they omit so many groups of cyclists on the road – it is essentially tracking ridership through a small group of self-selected users, leaving out anyone who rides without using a specific app. This almost makes certain that respondents will not be representative of the greater population of any city, as no city is completely made up of Strava-using cyclists.

Even the strongest studies in this review were faced with limitations. While video and virtual studies such as Guo et al., Knight and Charlton, and Monsere, McNeil, and Sanders provided an innovative way to review cyclist opinions, the safety of a virtual or video environment is certainly higher than any real-world roadway environment.

Supplementing with real-world studies (as in the case of Knight and Charlton) helps to overcome these limitations, though this study admits that often the participating cyclists were alone on the road.[71]

66. Tuckel and Pok-Carabalona 10-11
67. Cicchino et al. 11
68. McNeil, Monsere, Dill, 132.
69. McNeil, Monsere, Dill, 133.
70. Michael Garber, et al., "Have Paved Trails and Protected Bike Lanes Led to More Bicycling in Atlanta: A Generalized Synthetic-Control Analysis." Epidemiology 33, No. 4 (2022): 493-504, http://doi.org/10.1097/EDE.0000000000001483
71. Knight and Charlton, 9.

Additionally, the survey population in studies in this review were not random samples. Manaugh, Boisjoly, and El-Geneidy used the student and staff population at McGill University, Monsere, McNeil, and Sanders used a population of self-selected cyclists who may have had stronger opinions, and McNeil, Monsere, and Dill cite the homogeneity of their mail-survey population as a limitation of their own study.

Existing projects to prevent or report obstructions in the bikeway

The literature on existing projects to prevent obstructions in the bikeway was less plentiful than literature on reporting these obstructions. While this planning report focuses more on highlighting issues that cause obstructions, this literature review will look at the existing examples of both prevention and reporting. Like the mindset that informs Vision Zero principles, this report seeks to characterize bikeway obstructions as a systemic problem rather than pinning blame on a specific individual or individuals. Focusing on the reporting of these obstructions veers too far into the realm of law enforcement and thus shifts the burden from system reform onto punishing individuals. This review will look at the literature on existing programs which are primarily user-created as opposed to municipal projects.

The study by Basch, Ethan, and Basch from 2019 showed that while New York City had spent a lot of time and money on bicycle safety initiatives, clearing or preventing bikeway obstructions with a targeted program was not a focus or element of the city's work.[72] This study cites the issue of police vehicles obstructing the bike lane as an element antithetical to municipal efforts to address bike safety, as well as the city' lack of attention to bike lane obstructions in a cycling safety action plan, despite the prevalence of obstructions recorded in their study.[73] Tuckel and Pok-Carabalona's work echoes this sentiment, claiming that cities must find ways to counteract structural issues that create enduring bike lane obstructions (such as construction sites) which can block the bike lane for hours or days on end.[74] This study bemoans the lack of existing plans or municipal efforts to examine these necessary changes within New York.

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A more recent 2023 study by Basch et al. spoke of a potential pilot program in New York, allowing residents to report bikeway obstructions.[75] While this study focuses on shared micromobility vehicles like scooters, these vehicles use the same infrastructure as bicycles and are subject to the same obstructions. Additional research into this unique pilot program (from news articles as opposed to scholarly sources) found that it encourages citizens to report bikeway obstructions through financial incentives – each instance of obstruction will net the reporter 25 percent of the cost of the ticket.[76]

72. Basch, Ethan, Basch, 397.
73. Basch, Ethan, Basch, 398.
74. Tuckel and Pok-Carabalona, 10
75. Corey Basch et al., "Micromobility Vehicles, Obstructions, and Rider Safety Behaviors in New York City Bike Lanes." Journal of Community Health (2023): 1-4, https://doi.org/10.1007/s10900-023-01197-6
76. Ron Johnson, "New York City bike lane blocking program could be a life-saver." Momentum Magazine, October 31st, 2022. https://momentummag.com/new-york-city-bike-lane-blocking-program-could-be-a-life-saver/

This "bike lane bounty" program is being replicated in Austin, Texas through their municipal 3-1-1- app.[77] Cities choosing to use financial incentives to report bikeway obstructions has both positive and negative impacts. Certainly, the motivation for citizens to report obstructions may increase with a potential payout.

However, this shifts the focus away from structural changes and develops a culture of "snitching" amongst city residents, pitting residents against each other as opposed to working together to solve the problem. These programs have the potential to generate fines for working people without looking at the reasons that the obstruction occurred in the first place. Similar programs to report bikeway obstructions exist in San Francisco and Philadelphia, though they were created by residents as opposed to by municipalities. An article by Moran recounts the *Safe Lanes* app, created by a frustrated San Francisco resident. *Safe Lanes* automatically forwards reported bikeway obstructions to the city's Municipal Transportation Authority customer service center.[78] Moran cites the fact that enforcement falls short of the number of reported blockages in the densest areas of San Francisco, and that the areas with the highest obstruction rates are where current infrastructure does little to prevent obstruction of the lane.[79] This study recommends protected bike lanes in these high-obstruction locations – there were close to 10,000 obstructions reported in an 8-month period.[80] In Philadelphia, the city's parking authority attempted to use a Twitter hashtag (#UnblockBkeLanes) to shame people who blocked the bike lane.[81] The hashtag failed to generate change in Philadelphia, which prompted a resident to develop an app called Philly Bike Report to create a more robust method for viewing bike lane obstructions in Philadelphia and spatially displaying where they frequently occur.[82] Montgomery's thesis on the development of this app cites a lack of protected bike lanes as a reason for the high quantity of obstructions. At the time of publication, Philadelphia did not have any protected bike lanes.[83] Montgomery also cites a similar app in Toronto called *MyBikeLanes*, though research today shows little evidence of this app's continued usage.[84] Like the bounty programs in New York and Austin, this highlights the issue while placing the focus on enforcement. Reporting serial offenders through their license plate is important from an enforcement standpoint but continues to shift to focus away from the problem at hand.

These studies attempt to categorize and record bike lane obstructions through either an observational approach, or an app approach which outsources the observations to a wider user base. There are limitations to both approaches. The purely observational studies such as Basch, Ethan, and Basch, and Tuckel and Pok-Carabalona cite issues with small sample sizes [85] and data collection accuracy [86] as factors that limited the effectiveness of their surveys.

77. Johnson.
78. Marcel Moran, "Eyes on the Bike Lane: Crowdsourced Traffic Violations and Bicycle Infrastructure in San Francisco, CA." Transport Findings (2020), https://doi.org/10.32866/001c.12651
79. Moran 2
80. Moran 2
81. Montgomery 9
82. Montgomery xiv
83. Montgomery 1
84. Montgomery 22
85. Basch, Ethan, Basch 398.
86. Tuckel and Pok-Carabalona 3.

On the other hand, the apps cited in the Moran study and Montgomery thesis potentially suffer from the opposite problem – a low level of understanding as to who is submitting reports of obstructed bikeways, what their motivations are, what their biases are, and the fact that these users may not be representative of their neighborhoods as a whole.[87] Montgomery's thesis also relies on significant anecdotal evidence about the performance of a municipally driven hashtag.[88] More peripherally, these limitations (especially the motivations of the users) apply to the bounty-style programs in New York and Austin. All these factors point to a need for municipal programs to prevent bikeway obstructions as opposed to citing obstructions as they occur – effectively treating the symptom, not the cause. Programs created by civic leadership hopefully would be driven by proper motivation and would not inordinately punish or burden people who are already facing higher levels of policing within their communities.

Methods and programs to re-allocate or creatively use space

Much of the literature on curb management studies focused on elements outside of the scope of this review. This review narrowed a focus specifically to articles related to the impacts of curb management strategies on bikeways, with a special focus on the effects of curb uses on bikeway obstructions. These studies followed one of two themes: space at the curb can be managed to build in additional space for bikes to promote safety, and cities can promote flexible curb uses other than traditional parking to reduce multimodal conflicts in the bike lane.

Studies by Moran in San Francisco and Butrina et al. in Seattle highlighted the impacts of delivery vehicles on bicyclist safety in an urban environment. Moran studied the effectiveness of an app (Safe Lanes) designed to report obstructions of the bikeway. Over half of the 10,000 reported obstructions through the app were either passenger or freight delivery vehicles.[89] Moran questioned the effectiveness of lining the curb with hourly parking zones when rideshare (passenger delivery) or freight vehicles were so frequently blocking the bike lane in trying to pick up or drop off.[90] His article suggested the use of more flexible curb loading zones to prevent obstructions[91], which has the potential to re-allocate space based on active usage demands as opposed to simply reserving the curb for car storage. This concept was further explored in Butrina et al.'s study of CVLZs in Seattle. Interviews with bicyclists and truck drivers pointed to flexible commercial loading zones as a desirable use of the curb for both modes[92], which often conflict with each other in dense urban environments. Butrina's interviews found that truck drivers will park nearest the business they are serving regardless of whether the spaces they occupy are legally permitted.[93]

87. Moran 3.
88. Montgomery
89. Moran 4.
90. Moran 4.
91. Moran 4.
92. Butrina et al.
93. Butrina et al., 22.

Creating additional flexibility in curb uses to create loading zones in areas where freight and bicycles interact can increase safety. This study did not observe any incidents between bikes and trucks during the period in which trucks enter or exit CVLZs.[94] This study also noted that 83 percent of cyclist/truck crashes took place at or near intersections and recommended additional care and planning at these potential conflict points.[95] These findings mirrored the studies of Cicchino et al (higher risk of accidents at the intersection thus demanding a special planning focus[96]), Monsere, McNeil, and Sanders (mixing with car traffic at intersections particularly affected the "interested but concerned" group[97]) and Lusk (parking setbacks at intersections would improve cyclist safety ratings of bikeway infrastructure, even on cycle tracks[98]).

From a safety perspective, studies in this review pointed to additional space allocation at the curb to increase perceived rider safety. A study in Montreal by Lusk et al showed that allocating more space for bicyclists at the curb (with an emphasis on protected space) can lead to higher rates of bicycling mode share as well as reducing crashes and injuries.[99] Silva, Moeckel, and Clifton studied bicyclist car interactions in different lane treatments in Munich and found that even an additional half-meter of buffered space can generate a positive outcome in reducing these interactions.[100] This same Munich study found that allocating additional curb space for protected bike lanes (or even bike lanes on a wider sidewalk) reduces the frequency of complex multimodal interactions, and therefore increases potential safety[101], noting that obstructions occur in both types of lanes, but the safety risks are much higher in on-street lane obstructions. A literature review by Schimek echoed these sentiments, examining the use of buffers in addition to standard bike lanes to move cyclists out of the path of car doors via creating additional space.[102] Schimek's assertion was expanded upon in several studies included in this review (e.g., McNeil, Monsere, and Dill, Knight and Charlton) which point to physical or vertical buffers as doing a better job than painted buffers.

The limitations to the studies that speak to these space allocation concepts are varied. Butrina's study of CVLZs in Seattle was able to interview a disproportionate number of cyclists when compared to truck drivers – only one group of truck drivers was willing to be interviewed.[103] Lusk's study, while using strong methods, is ten years old at this point – the professional opinion of buffered bike lanes has decreased with the adoption of protected bike lanes containing physical, vertical separation between bikes and cars.

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94. Butrina et al. 37
95. Butrina et al. 13
96. Cicchino et al. 11
97. Monsere, McNeil, Sanders 227
98. Anne Lusk et al., "Risk of injury for bicycling on cycle tracks versus in the street." Injury Prevention, 17 (2011): 131-135, https://doi.org/10.1136/ip.2010.028696
99. Lusk et al. 133
100. Cat Silva, Rolf Moeckel, and Kelly Clifton, "Comparative Observational Assessment of Cyclists' Interactions on Urban Streets with On-Street and Sidewalk Bike Lanes." Transportation Research Record 0, 0 (2022): 1-13, https://doi.org/10.1177/03611981221118539
101. Silva, Moeckel, Clifton 12
102. Schimek 1-9
103. Butrina et al. 21

This somewhat decreases the validity of recommending buffers given the innovations over the past ten years. To that end, the Munich-based research of Silva, Moeckel, and Clifton points to sidewalk bike lanes as a method of decreasing complex multimodal interactions.[104] If the pattern seen in Lusk's research applies here, American cities may still be ten years out from understanding and applying these bikeway treatments with higher frequency – even the most current North American literature in this review does not speak to sidewalk bike lanes as an independent type of bikeway.

Limitations aside, these studies do highlight the need to properly allocate space at the curb to promote cycling as a safe mode of transportation. Silva, Moeckel, and Clifton assert that "interventions to meet these safety aims include providing sufficiently wide bike lanes that are clear, devoid of obstacles, and avoid interactions with other road users."[105]

The literature in this review shows that planners, governments, and citizens have found ways to innovate and improve bikeway infrastructure. Moran's assertion that this same logic must be applied to re-imagining curb usage for something beyond simple hourly parking[106] is incredibly important towards creating a safer environment at the curb. The literature shows that intersections and driveways are points of conflict – this literature review and forthcoming study aims to add the curb zone to that list of focus points for planners.

Conclusion

The most overwhelming finding of the literature in this review is that protected bikeways create safer environments and increased ridership, but do not necessarily prevent obstruction. Rather, the type of obstruction or conflict tends to change based on bikeway infrastructure type. Studies show that obstructions due to cars are more common in painted bike lanes, but obstructions due to objects, pedestrians, or other people using non-car modes of transportation tend to proliferate in protected bikeways. Regardless of the prevalence of obstructions, protected bikeways rate safer in video and virtual tests, on-road tests, and surveys. Data collection from hospitals shows lower injury rates from protected bike lanes. There was more literature on this topic than this review as able to cover. Further research may be needed into sidewalk-based bike lanes, which are referred to in European studies but less so in the US and Canada. Anecdotal evidence shows that these treatments are much newer and infrequently used to date in North America.

The literature also highlights that many efforts to prevent or report bikeway obstructions are user-based, with municipal programs only coming into existence in the last two years or so. Further research is needed on best practices for municipal programs to report and prevent bikeway obstructions.

104. Silva, Moeckel, Clifton 10
105. Silva, Moeckel, Clifton 3
106. Moran 4

Existing bounty-style programs such as New York and Austin have the potential to create equity issues with working people at higher risk of being ticketed, as per the Butrina et al. study in Seattle.

Programs that are driven to change the systems that cause obstructions in the first place (such as private vehicle parking in commercial business districts) can have a positive effect on reducing obstructions without promoting a culture of city residents informing on each other for monetary gain. Kirschner’s study in Munich about street user conflicts highlighted that the competition for open space in cities often leaves cyclists and pedestrians on the short end of the stick, or even pitted against each other.[107] It is important to create sensible methods for reducing bikeway obstructions that rely on changing the system environment as opposed to deputizing individuals to solve the problem on their own.

Finally, the literature spoke to the challenges that bicycles and commercial vehicles face when the compete for limited space within the city. More research on curb management strategies to reduce the impacts of freight and passenger delivery on cyclist safety is needed to promote more modern uses of the curb. Cities trying to reduce drive-alone rates should consider giving up so much of the right of way to private car parking, despite the potential revenue from meters. My future research will aim to categorize the environment in which obstructions are regularly occurring to look at site or district-specific treatments that could potentially reduce these conflicts.

107. Franziska Kirschner, “Parking and competition for space in urban neighborhoods: Residents’ perceptions of traffic and parking-related conflicts.” Journal of Transport and Land Use 14, no. 1 (2021): 603-623, http://dx.doi.org/10.5198/jtlu.2021.1870

Figure 1.4: Dumpster obstructing the bike lane on Mandela Parkway in Oakland. Source: Instagram Submission by user @dangerventure

A description of research methods used in the study

This report utilizes a mixed-methods approach, combining in-field data collection with qualitative interviews conducted with transportation planners in each of the study cities. Field data collection is necessary to understand the types of obstructions that are occurring in each city as well as the frequency with which they occur. This data was collected through taking photographs and logging pertinent information from each photograph into a spreadsheet. The spreadsheet contains information such as the location of the obstruction, the type of obstruction, the time and day of obstruction, the prevailing land use in the area, bike lane classification, and the presence of on-street parking, among others. Each photo taken on an iPhone has the requisite locational data, as well as the date and time of the photo. This was transcribed from each photo into the spreadsheet.

Over 90 percent of the obstructions were recorded by the author, however a small subset of obstructions was submitted to the author from residents of Oakland, California. The author maintains an Instagram account (@whatsinthebikelaneoakland) and submissions of user-recorded bike lane obstructions were sent via direct message to this account. These photos were downloaded, added to the spreadsheet, and categorized in the same manner as the data collected by the author.

Originally, data was to be collected using Esri Survey123, a field survey program that allows users to develop a survey and collect data using a mobile device, geolocating each data point on a map. After initial testing, Survey123 proved to be too laborious for in-field data collection, especially when having to quickly pull over while bicycling. Attempting to fill in all the requisite fields in the Survey123 field app while on the sidewalk also felt unsafe at times. Minimizing the amount of time that a cell phone was exposed in some places felt like the right decision.

During and after data collection, interviews were conducted with transportation planners in Oakland and San José who work on the development and maintenance of each city’s bike program. These interviews will aid in understanding the existing municipal efforts to counteract bike lane obstructions, as well as providing information on the general level of importance that bike lane obstructions are given at a municipal level. Additionally, this report will compare its own findings with findings from transportation planners who have attempted to reduce obstructions to understand potential overlaps and gaps in each party’s work that can be filled in. These interviews will help to inform the potential policy suggestions made clear through the analysis of the collected obstruction data.

Overview of Findings

Data for this project was collected between April 2022 and August 2023, with the bulk of the data collection coming between August 2022 and August 2023. During the data collection period, a total of 226 obstruction instances were recorded. 86 obstructions were recorded in Oakland and 140 obstructions were recorded in San José. In specific cases, there were multiple objects comprising a single obstruction. For example, there were 41 instances where more than one object was obstructing the bike lane. The overall number of cumulative physical obstructions – added up over the totality of recorded obstructions – was 370, with 91 occurring in Oakland and 279 occurring in San José.

Looking at the entire dataset revealed several overarching patterns. First, the presence of a Class IV (protected) bike lane had the clear effect of reducing the number of obstructions when compared to a Class II (painted, but not physically separated) bike lane. In Oakland, there were 2.07 times as many recorded Class II obstructions as Class IV obstructions. In San José there were 2.02 times as many recorded Class II obstructions as Class IV obstructions. Even though the number of obstructions recorded in San José (n=140) was greater than the number of obstructions recorded in Oakland (n=86), the disparity between Class II and Class IV obstructions remained relatively constant across both study cities.

Second, while obstructions in Class IV bikeways were less common than Class II bike lanes, an obstruction in a Class IV bikeway was more likely to present the rider with no viable option to proceed around the obstruction. Obstructions in Class II bike lanes usually force the rider to merge with motor vehicle traffic to bypass the obstruction. Obstructions in Class IV bikeways – especially if the bike lane is fully protected with hardscaped elements – can often force the rider to fully dismount their bike and walk around the obstruction. Guidance from the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide points to Protected Cycle Tracks (Class IV bikeways fall into this category) as a more attractive infrastructure type for bicyclists of all levels and ages.[108] Additionally, the Urban Bikeway Design Guide recommends hardscaped or parking-protected cycle tracks over using bollards[109] - while this strategy is more effective of keeping cars out of the bike lane, this research shows that it can have the unintended effect of trapping bicyclists in the case of an obstruction.

Finally, the most common types of bike lane obstructions can vary from city to city, as specific city policies can have an outsized effect on the existence of certain obstructions. For example, the City of San José's policies regarding yard waste and garbage collection led to a significant increase in these sorts of obstructions, especially when compared to Oakland. In San José, there were ten times as many recorded obstructions from yard waste or waste receptacles as compared to Oakland.

108. National Association of City Transportation Officials, *Urban Bikeway Design Guide*. Accessed September 4, 2023, https://nacto.org/publication/urban-bikeway-design-guide/
109. *Urban Bikeway Design Guide*

Chapter 2: Categorization of Bike Lane Obstructions and Bike Lane Obstructors

The following chapter seeks to define the categories of bike lane obstructions that occur in each city, as well as the different categories of those individuals or objects that obstruct the bike lane. It is important to note that each obstruction was categorized by one researcher. The best possible effort was made to determine the intent of the obstruction from observing obstructions in the field. Additionally, it was not always possible to ensure or determine the motivations of a particular street user. Again, the best possible effort was used to select a category of obstruction during data collection.

Conceptual categories for potential obstructions were created prior to data collection. Additionally, potential obstruction types were brainstormed prior to data collection and augmented with real-world feedback from in-field data collection.

Chapter 2a: Obstructions and Obstructors - Systemic Obstructions

Systemic obstructions can be defined as obstructions that occur because the obstructor has no other defined place to go. There is no system in place which provides a convenient, useful, or accessible spot – therefore, a choice is made to obstruct the bike lane.

Any of the following could be categorized as a systemic obstruction:

- Delivery drivers, such as UPS, FedEx, U.S. Postal Service, or Amazon – who must deliver a package but do not have anywhere to park or lack a nearby loading zone.

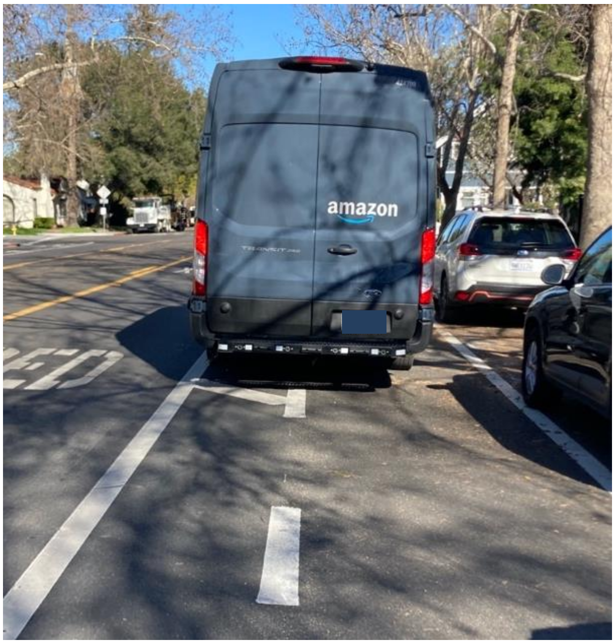


Figure 2.1: Amazon.com delivery truck obstructing the bike lane in San José.

- On-demand or app-based delivery drivers, such as DoorDash, UberEats, or Postmates drivers, who are making a delivery and do not have anywhere to leave their automobile for a short term. DoorDash drivers, as an example, are not reimbursed for any parking tickets they incur while at work. DoorDash places all the onus for deciding how to park while delivering an order on the driver[110] – specified in documentation as a contractor, not an employee. In this case, both municipal curb management systems and internal delivery app systems are contributing to a driver's decision to obstruct a bike lane. Determining whether someone was obstructing the bike lane as a private citizen, or as a contractor for an app-based delivery service was somewhat subjective. The judgment was made based on the location of the obstruction and the status of the car's emergency blinking lights. If a car was idling, had its emergency blinkers on, or was obstructing the bike lane in front of a restaurant or series of restaurants, it was determined to be an app-based delivery obstruction.

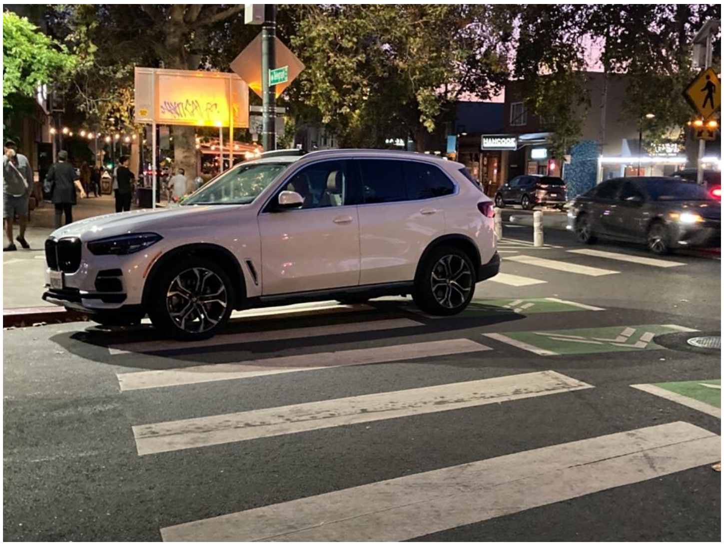


Figure 2.2: Presumed app-based delivery driver obstructing the crosswalk and bike lane, Oakland.

Figure 2.3: Several presumed app-based delivery drivers obstructing the bike lane, San José.

110. "Can I be reimbursed for toll, parking fees, parking tickets or traffic tickets?", DoorDash Dasher Support, DoorDash, accessed May 9th, 2023, https://help.doordash.com/dashers/s/article/Can-I-be-reimbursed-for-toll-parking-fees-parking-tickets-or-traffic-tickets?language=en_US

- Trash cans, which have no other specified place to go. Bin placement varies from city to city, certain cities specify that these remain on the sidewalk or curb, while others expect users to place these cans where cars traditionally park. Often, to permit for trash pickup and car parking, these cans migrate to the bike lane. Additionally, larger dumpsters without a specific pickup spot can obstruct the bike lane. It must be stated that the obstructor could obstruct a car travel lane instead – it is a choice to obstruct the bike lane. Choosing to obstruct the bike lane instead of a car lane highlights the importance that is often placed on cars and auto travel in our cities, and the devaluing of bicycling and bicyclists. Blocking a travel lane has the potential to cause muti-car traffic backups or incite anger from other motorists.

Figure 2.4: Dumpster obstructing the bike lane, Telegraph Avenue, Oakland.

Figure 2.5: A collection of trash and recycling cans obstructing the bike lane, San José.

Chapter 2b: Obstructions and Obstructors - Willful Obstructions

Willful obstructions can be defined as an obstruction of the bike lane that occurs because someone chooses to obstruct it. In this case, an alternative parking space is present, but perhaps less convenient. Any of the following could be categorized as a willful obstruction:

- Parked (and idling) private vehicles. This could be individual drivers or, more commonly, rideshare drivers, such as Uber or Lyft drivers. Instead of looking for a parking spot, temporarily blocking a driveway, or circling the block, these drivers choose to obstruct the bike lane instead. This also includes drivers who have simply chosen to park in the bike lane, or cars that are parked legally but are so wide that they obstruct the bike lane.

Figure 2.6: Idling private vehicle obstructing the bike lane, Oakland.

Figure 2.7: Parked private vehicle obstructing the bike lane, San José.

This project did not measure vehicles that were simply too wide for the designated parking space, but this was an issue that resulted in obstructions next to proper parking spots due to excessive vehicle width.

- Police obstructions, except for in the case of a sirens-on emergency. Police officers have been frequently reported to block the bike lane when pulling over a car or conducting other routine aspects of their job.

Figure 2.8: Oakland Police obstructing the bike lane on Broadway near 27th Street.

Figure 2.9: San José Police parked in the bike lane on S. 4th Street next to San José State University.

Figure 2.10: Oakland Police parked on the bike lane separator, obstructing the view of cyclists at the corner and driveway interaction.

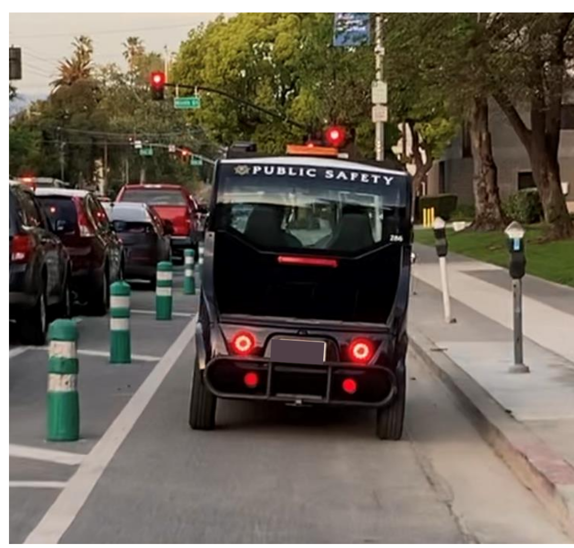
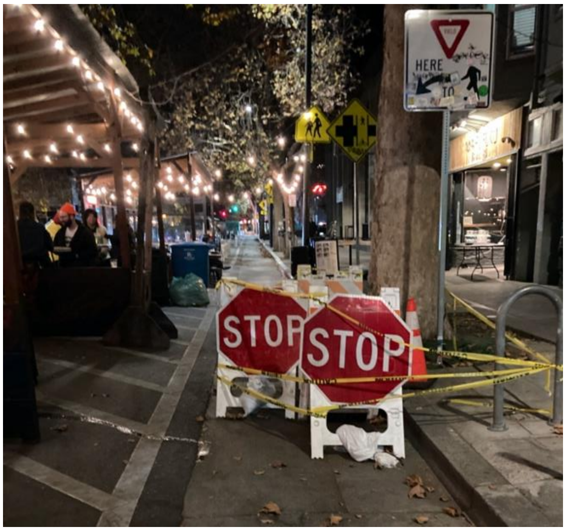


Figure 2.11: San José State University campus security parked in the bike lane on E. San Fernando Street next to San José State University.

- Construction vehicles or construction equipment – proper construction permits should include a space for each necessary construction vehicle. Failure to acquire or use these permits and to instead obstruct the bike lane is a willful obstruction. Additionally, extra vehicles that are not essential to performing the specified duties at the construction site could be parked elsewhere in lieu of obtaining a permit to block off street parking. Besides vehicles, construction equipment such as signage, barriers, fences, and immovable equipment may also obstruct the bike lane.



Clockwise, from bottom left:
Figure 2.12: Construction equipment parked overnight in the bike lane, Telegraph Avenue, Oakland.

Figure 2.13: Construction site temporary office obstructing the bike lane without permission, S. 4th Street in San José.

Figure 2.14: Construction signage obstructing the bike lane without an active construction project, Telegraph Avenue, Oakland.

Chapter 2c: Obstructions and Obstructors - Chaotic Obstructions

Chaotic obstructions can be defined as obstructions of the bike lane that happen without a true motive, happen due to intentional chaos creation, or obstructions that occur due to weather events such as storms or wind. Additionally, chaotic obstructions include inanimate objects in the bike lane. While it is not possible to know for sure how many objects arrived in the lane, it is very clear that the objects did not arrive under their own power. Any of the following could be categorized as a chaotic obstruction:

- Objects, such as dumped garbage, debris, shopping carts, or bags of trash. Creating an exhaustive list of items dumped in the bike lane would be nearly impossible.

Figure 2.15: Dumped household appliance obstructing the bike lane on E. Empire Street in San José.

Figure 2.16 Dumped furniture obstructing the bike lane on Market Street in Oakland.

- Dockless shared micromobility vehicles, such as scooters, which are supposed to be parked in a specific place on the sidewalk but often find their way into bike lanes. Administrative regulations between micromobility operators (Bird, Lime, e.g.) and Cities require scooters to be parked in a specific way – not in the bike lane, not in the sidewalk through zone, not within a specific distance of a fire hydrant, not blocking a driveway, curb ramp, or doorway.[111]

111. *City of San José Municipal Code*, Chapter 11.92. Accessed October 7th, 2023, https://library.municode.com/ca/san_José/codes/code_of_ordinances?nodeId=TIT11VETR_CH11.92SHMIBIDE

Figure 2.17: Shared micromobility device (Scooter) obstructing the bike lane on E. San Fernando Street in San José.

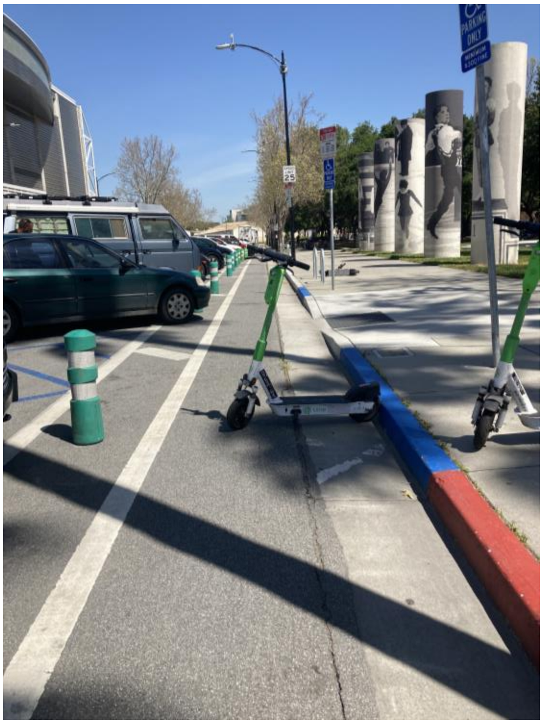


Figure 2.18: Shared micromobility device (Scooter) obstructing the bike lane on Barack Obama Boulevard in San José.

The following chapter will explain the general methodology and data collection procedure used throughout the duration of this project. Additionally, city-specific methodology for both Oakland and San José will be outlined.

Chapter 3a: General Methodology for Data Collection

Data for this project was collected over a period beginning in April 2022 and ending in September 2023. To begin data analysis, a cutoff date of September 1st was set after which no more data would be collected. This project could effectively continue forever. Setting a hard cut-off for data collection was essential towards advancing the project towards its completion. Data was collected on Class II bike lanes and Class IV bikeways, but not on Class I bikeways (a bike path, fully separated and independent from automotive thoroughfares) or Class III bikeways (where cars and bikes share the entire road without a striped or separated bike lane). Obstructions on Class I bikeways are often completely different from those found on Class II bike lanes and Class IV bikeways, as Class I bikeways do not interact with streets, sidewalks, businesses, or residential areas. Class III bikeways do not have markings on the road from which to derive an obstruction[112], therefore these were excluded from data collection.

Data was primarily collected by the author while out bicycling. Data collection in each city was limited to a specific area. The collection area for Oakland was limited to an area that can generally be described as the 'flatlands.' The boundaries of this area in the scope of this project are I-880/Embarcadero to the South, I-880/I-80/the Oakland/Emeryville border to the west, the Oakland/Berkeley border to the north, and I-580/the Oakland/Piedmont border to the east. The collection area for San José was limited to an area that can be described as Central and Central-East San José. The overwhelming majority (n=137) of the recorded obstructions) were in the neighborhood bounded by King Road to the east, I-680/I-280 to the south, Race Street/The Alameda to the West, and Hedding Street to the north. A small number of obstructions (n=3) of the recorded obstructions) were recorded on a trip further east in San José, as far as White Road.

Data collection took place during both the morning commute hours, afternoon/early evening commute hours, and over the weekend. For trips taken during morning commute hours, one of several specific routes was taken between the Author's home and MacArthur BART. Another list of routes was consulted for the trip from Berryessa/North San José BART to Downtown San José. On the return trip to Oakland, a different route was taken on each leg of the return trip. To add on additional mileage for data collection, the return trip often alighted at Lake Merritt BART to traverse several of the defined Oakland routes.

112. California Department of Transportation. *Highway Design Manual*, Chapter 1000 – Bicycle Transportation Design. July 1, 2020, https://dot.ca.gov/-/media/dot-media/programs/design/documents/chp1000-a11y.pdf

Table 3.1: Primary Routes used for Data Collection in Oakland

Street	From	To	Bikeway Class	Centerline Lane Length (mi.)	Primary Land Use (simplified)
Telegraph	40th	51st	IV	0.75	Commercial
Broadway	38th	College	II	0.78	Commercial
Lakeside	14th	19th	II	0.33	Open Space/Residential
Lakeside	19th	W. Grand	IV	0.44	Open Space/Commercial
Harrison	W. Grand	27th	II	0.14	Commercial
27th	Harrison	Telegraph	II	0.46	Commercial
Lakeshore	E. 18th	El Embarcadero	II	0.69	Open Space/Residential
Telegraph	29th	21st Street	IV	0.58	Commercial
Miles	College	Forest Street	II	0.17	Residential
College	Claremont	Manila Street	II	0.65	Commercial
Piedmont	Pleasant Valley	41st	II	0.39	Commercial
Piedmont	41st	W. MacArthur	II	0.31	Commercial

A total of 12 routes – nine Class II and three Class IV routes were set as primary data collection routes in Oakland. Data collection was not limited to these routes, but these routes were derived from the Oakland Bikeway Network map and were selected to provide the best possible mix of land uses, bikeway classification, and neighborhood within the study area. The total mileage of these routes is 5.69 miles, with 3.92 miles of Class II bike lane and 1.77 miles of Class IV bikeway.

Table 3.2: Primary Routes used for Data Collection in San José

Street	From	To	Bikeway Class	Centerline Lane Length (mi.)	Primary Land Use (simplified)
San Fernando	1st	S. 10th	IV	0.61	Commercial/ University
San Salvador	10th	S. 4th	IV	0.4	Commercial/ University
Empire	21st	N. 10th	II	0.6	Residential
10th	Empire	St. John	IV	0.57	Residential
17th	St. John	Empire	II	0.57	Residential
3rd Street	William	Julian	IV	0.96	Commercial
San Fernando	Montgomery	S. 1st	IV	0.8	Commercial
7th	St. John	Empire	II	0.57	Residential

A total of eight routes – three Class II and five Class IV routes were set as primary data collection routes in San José. Data collection was not limited to these routes, but these routes were derived from the San José Bikeway Network map and were selected to provide the best possible mix of land uses, bikeway classification, and neighborhood within the study area. The total mileage of these routes is 5.08 miles, with 1.74 miles of Class II bike lane and 3.34 miles of Class IV bikeway.

Data was also obtained any time the author was out bicycling or walking within the study areas of each city. This allowed for weekend data collection, mid-day data collection, and the capture of a wider breadth of each city's bikeway network and the obstructions that occur in these locations.

Finally, data was submitted to the author through social media. An Instagram account (@whatsinthebikelaneoakland) was started prior to the official data collection period. User submitted photographs of bike lane obstructions were categorized in the same way as the data physically collected by the author.

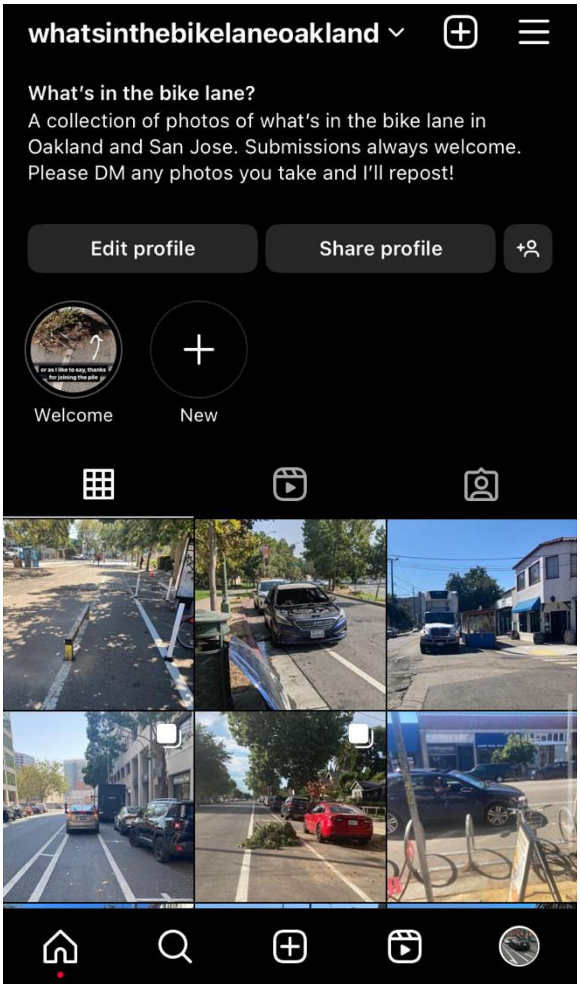


Figure 3.1: Screenshot of Instagram account profile associated with this report. Users submitted bike lane obstructions to the author via private message.

Figure 3.2: Screenshot of Instagram post example.

Chapter 3b: Data Collection Process

Upon spotting a bike lane obstruction, a photograph of the obstruction was immediately taken. Obstructions were often spotted while actively riding a bike, so pulling over or stopping in the bike lane was often necessary to take a photo. Some photos were taken while riding, though this was not done regularly for safety reasons. It was not reasonable to collect data for this project while remaining stationary – the chances of a bike lane obstruction occurring while in one place seemed exceedingly low, so for the purpose of data collection, the routes outlined in Tables 1 and 2 were used as a starting point.

The author's phone was set to record locational data with each photograph – the phone automatically appends the time and date. For both efficiency and safety's sake, no further information was written down while in the field. Upon conclusion of a single obstruction recording session, each photo was transferred to a spreadsheet, with separate sheets for Oakland and San José. Each sheet – regardless of study city – contained the same columns:

- Image of Obstruction in the field
- Latitude
- Longitude
- Day of Week
- Date
- Time
- Street
- Nearest Cross Street
- Bike Lane Classification (II or IV)
- Number of Total Physical Obstructions
- Type of Obstruction

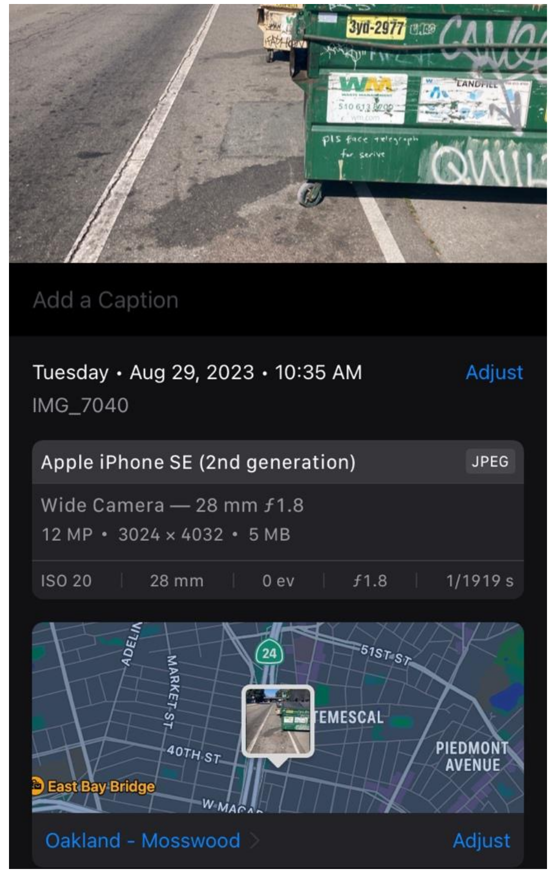


Figure 3.3: Screenshot of GPS data associated with each photograph taken for this report and a close-up view of the same information.

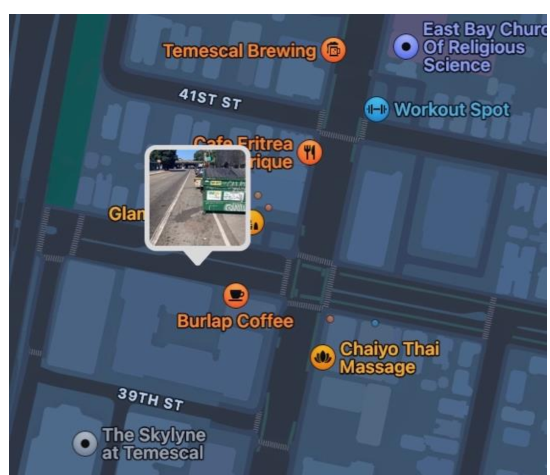


Figure 3.4: Screenshot of Data Tracking Spreadsheet showing Main Columns

1	Image	Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Classifcation	Number of Obstructions	Type of Obstruction
2		37°49'38.75" N	122°15'54.88 "W	Friday	8/5/2022	9:55:28 AM	Telegraph	Apgar	IV	1	Garbage Can/Dumpster
3		37.81052544	-122.2694016	Friday	8/5/2022	1:48:20 PM	Telegraph	21st	IV	3	Parked Vehicle (Private)
4		37°47'15.19" N	122°14'57.47 "W	Friday	8/5/2022	7:09:37 PM	Embarcadero	16th Avenue	II	1	Dumped Object

Using Google Maps in conjunction with the locational data recorded by the iPhone camera, the coordinates of each obstruction were entered into the sheet, along with the rest of the columns. The Oakland Bikeways Map and San José Bikeways Map were consulted if there was any confusion about the bike lane classification. If obstructions were recorded as a video, a screen capture was taken to represent the obstruction instance in the sheet, and the number of total recorded obstructions was counted.

As data was collected, the *Type of Obstruction* category began to develop into a clear set of obstruction types, able to characterize all the obstructions recorded during the data collection process. Cars in the process of parallel parking or emerging from a parking spot into traffic were not recorded as obstructions. Any car actively moving out of the bike lane was not recorded as an obstruction. Whether that car previously was an obstruction is unknown, therefore this study cannot extrapolate anything that happened prior to arriving at the scene.

Additionally, while broken glass is a major issue in all bikeways, it was not recorded as an obstruction for this project. There is simply too much broken glass on the street to stop and record it. Also, the reasons why broken glass appears at a specific location are more chaotic and less tied to infrastructure development or any of the other factors that this study examines. Glass is the most chaotic of obstructions, often appearing without any defined reason other than a car crash, car burglary, or a bottle being thrown from a moving vehicle.

The obstruction types as categorized for this study are listed in Table 3.3, which is seen on the following page.

Table 3.3: Types of Obstructions Found During Data Collection Period

Obstruction Type	Category	Description	Notes
Business Equipment	Chaotic	Commonly in the form of sandwich board style advertising signs placed in the bike lane, or unauthorized cones used by businesses to secure street parking that crossed into the bike lane.	
Construction/ Street Equipment	Willful	Commonly in the form of road signage, traffic message boards, or physical construction vehicles such as earth movers and excavators.	
Delivery Vehicle	Systemic	Trucks belonging to UPS, Amazon, FedEx, and the US Postal Service vehicles are all examples.	
Dumped Object	Chaotic	Often takes the form of home furniture, appliances, mattresses, and yard equipment.	
Dumpster/ Garbage Can	Systemic	This obstruction includes both commercial sized steel dumpsters and residential plastic bins.	
Parked Private Vehicle	Willful	This category includes vehicles used for app-based rideshare, such as Uber or Lyft, and app-based delivery such as DoorDash.	
Police Vehicle	Willful	Oakland Police, San José Police, and San José State University Police all obstructed the bike lane. No fire vehicles or ambulances were observed obstructing.	
Shared Scooter	Chaotic	Shared scooters tipped over from the sidewalk and obstructed the bike lane. Shared scooters in Oakland have a "lock-to" requirement (parked scooters must be locked to something after a ride, usually a bike rack). No dockless shared e-bikes were recorded.	Only seen in San José
Unbundled Yard Waste	Systemic	Oakland mandates the use of green waste cans and contractor bags to store home yard waste, but San José does not. Yard waste in San José is placed in the street in unbundled piles for collection by a specialized vehicle.	Only seen in San José
Vegetation/ Water	Systemic	This differs from yard waste in that these obstructions are not placed in the bike lane by residents but are due to lack of maintenance in the public right-of-way.	
Work Vehicle	Willful	This differs from a delivery truck in the fact that these vehicles remain static in the bike lane for the duration of the day and are usually found at a construction or job site.	

Chapter 3c: Oakland-Specific Methodology

Oakland, in the Bikeways shapefile provided through their Open Data Portal[113], uses a more nuanced bikeway classification than San José. Instead of simply using Class II or Class IV, Oakland often appends letters or numbers (such as 4a or 4.2b) to their bikeway classifications. The decimal point refers to the fact that a bikeway class may be different on each side of a two-way street. A typically refers to an arterial street, and B typically stands for buffered. For this project, each bikeway classification was dissolved to the base bikeway classification – Class II or Class IV – to match up with San José's classifications and to keep all collected data in the same terminology.

Chapter 3d: San José-Specific Methodology

San José, when compared to Oakland, had a preponderance of obstructions related to refuse. Dumpsters, trash and recycling bins, and unbundled yard waste accounted for 52 percent of all obstructions recorded in San José. For each recorded instance of Dumpster/Garbage Can or Unbundled Yard Waste in San José, the day of the week in which the obstruction took place was manually cross-referenced with the City of San José Utility Services Lookup tool. An address corresponding to the approximate location of the obstruction was entered (collection does not vary within individual blocks so getting the exact address was not essential) and the Waste Pickup Day for the obstruction was noted. The Utility Services Lookup tool differentiates between residential and commercial waste pickup, as well as the day when yard trimmings pickup occurs. If the obstruction occurred on the day before scheduled waste pickup, the day of scheduled waste pickup, or the day after scheduled waste pickup, it was noted in a San José-specific column in the spreadsheet.

113. City of Oakland Open Data Portal. "Existing and Proposed Bikeways," Last modified February 7th, 2023. Accessed September 4th, 2023. https://data.oaklandca.gov/Infrastructure/Existing-and-Proposed-Bikeways/6e52-b8q8

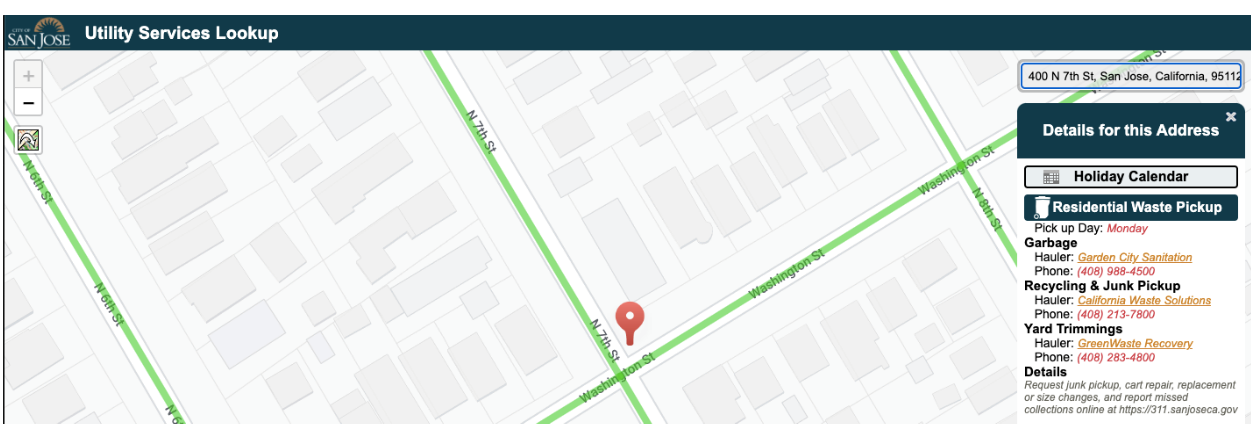


Figure 3.5: Screenshot of City of San José Utility Services Lookup Tool

Image	Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Classifcation	Number of Obstructions	Type of Obstruction	If: Unbundled Yard Waste or Dumpster/Waste Receptacle - Was it Garbage Collection Day?
	37°19'53.24"N	121°53'8.72"W	Monday	2/6/2023	2:20:25 PM	2nd	San Carlos	IV	1	Dumpster/ Garbage Can	Yes
	37°21'16.68"N	121°52'35.03"W	Monday	2/13/2023	3:19:57 PM	Empire	22nd	II	1	Dumpster/ Garbage Can	Yes

Figure 3.6: Screenshot of Data Tracking Spreadsheet showing Garbage Collection Day field

Additionally, the residential waste can obstructions often clustered together. Out of 50 total instances in San José in which a *Dumpster/Garbage Can* obstruction was recorded, 32 instances (64 percent) contained multiple cans agglomerated together. Data collection in these instances often included recording a video as opposed to taking photos. A video would more easily capture the scale of that specific obstruction, and the cans could be counted once out of the field. For this project, obstructions were limited to the length of one city block. Any time a series of obstructions continued across a new cross street a new obstruction was recorded.

Unbundled Yard Waste was another type of obstruction that only occurred in San José. The City makes yard trimming carts available to residents for an additional fee.[114] Presumably, to avoid paying the fee - $6.85 a month or $82.20 annually for a yard trimming cart of 32, 64, or 96 gallons[115] - many residents simply pile their yard waste in the right of way for pickup by a specialized vehicle. It should be noted that the City of San José contracts with multiple haulers who pick up yard waste, and each contractor has separate contract terms that last up to 15 years. Only specific haulers allow for unbundled yard waste. The City provides instructions on where to place yard waste trimmings, specifies the size of yard waste piles, and specifies what types of yard waste are permitted in these on-street piles. Unfortunately, this unbundled yard waste frequently obstructs the bike lane. *Unbundled yard waste* was not found in Oakland, where green waste bins are mandatory and any waste that does not fit in the green bin must be bundled or bagged in paper gardening bags, which are to be paid for by the resident.[116]

114. City of San José, "Yard Trimmings and Street Sweeping", Accessed September 17th, 2023, https://www.sanJoséca.gov/your-government/departments-offices/environmental-services/recycling-garbage/residents/yard-trimmings-street-sweeping
115. City of San José, "Rates & Billing", Accessed September 17, 2023, https://www.sanJoséca.gov/your-government/departments-offices/environmental-services/recycling-garbage/residents/garbage-recycling-rates-billing
116. Oakland Recycles, "Residential Compost, Recycle, Trash Services Guide", n.d., Accessed September 17, 2023, https://www.oaklandrecycles.com/wp-content/uploads/2022/02/Oak-SFD-MFD-Residential-Recycling-Guide-2022-ENG.pdf

Whenever an *Unbundled Yard Waste* obstruction was recorded, the date of the obstruction was cross-checked with the Utility Services Lookup based on the location of the obstruction. In the same manner as *Dumpster/Garbage Can* obstructions, if an *Unbundled Yard Waste* obstruction occurred on the day before scheduled waste pickup, the day of scheduled waste pickup, or the day after scheduled waste pickup, it was noted in a San José-specific column in the spreadsheet.

Chapter 3e: Transfer of Data from Spreadsheet to Esri ArcGIS Suite for Analysis, addition of external data sets

Upon conclusion of the data collection period, each study city's spreadsheet was exported as a CSV (comma separated values) file. Location coordinates of each obstruction were standardized into a single format (decimal degrees, not degrees, minutes, and seconds) for proper geocoding using ArcGIS Online. Each edited CSV file was uploaded to ArcGIS Online, saved as an independent feature class, and then downloaded for analysis in ArcGIS Pro. Once the data was contained within an ArcGIS Pro project, it could be symbolized in any number of ways to conduct specific analysis related to the obstructions and their location.

Several other existing data sets were brought into the ArcGIS Pro project to be cross-referenced with the location each obstruction. These data sets included:

- City-Specific Zoning. The cities of Oakland and San José make their zoning code available as a shapefile from their respective open data portals. These files were downloaded, added to the ArcGIS Pro project, and reduced to only include the specific zoned parcels that intersected an obstruction. Each city symbolizes their zoning differently. Oakland's zoning map extends from each parcel across the public right-of- way, but San José's zoning map leaves the public right-of-way as an un-zoned space between parcels. This simple difference required different methodology for noting the base zoning at each obstruction.
- In Oakland, the zoning could be selected by location using the intersection of the obstruction point with the parcel zoning polygon. In San José, since the obstructions occurred within the un-zoned public-right-of-way, the parcels had to be selected using a 70-foot radius around the obstruction. Each set of zoned parcels was exported as its own new feature class. Analyzing base zoning at the point of each obstruction helps to paint a picture of the impacts of land use on bike lane obstructions – both their quantity and form.

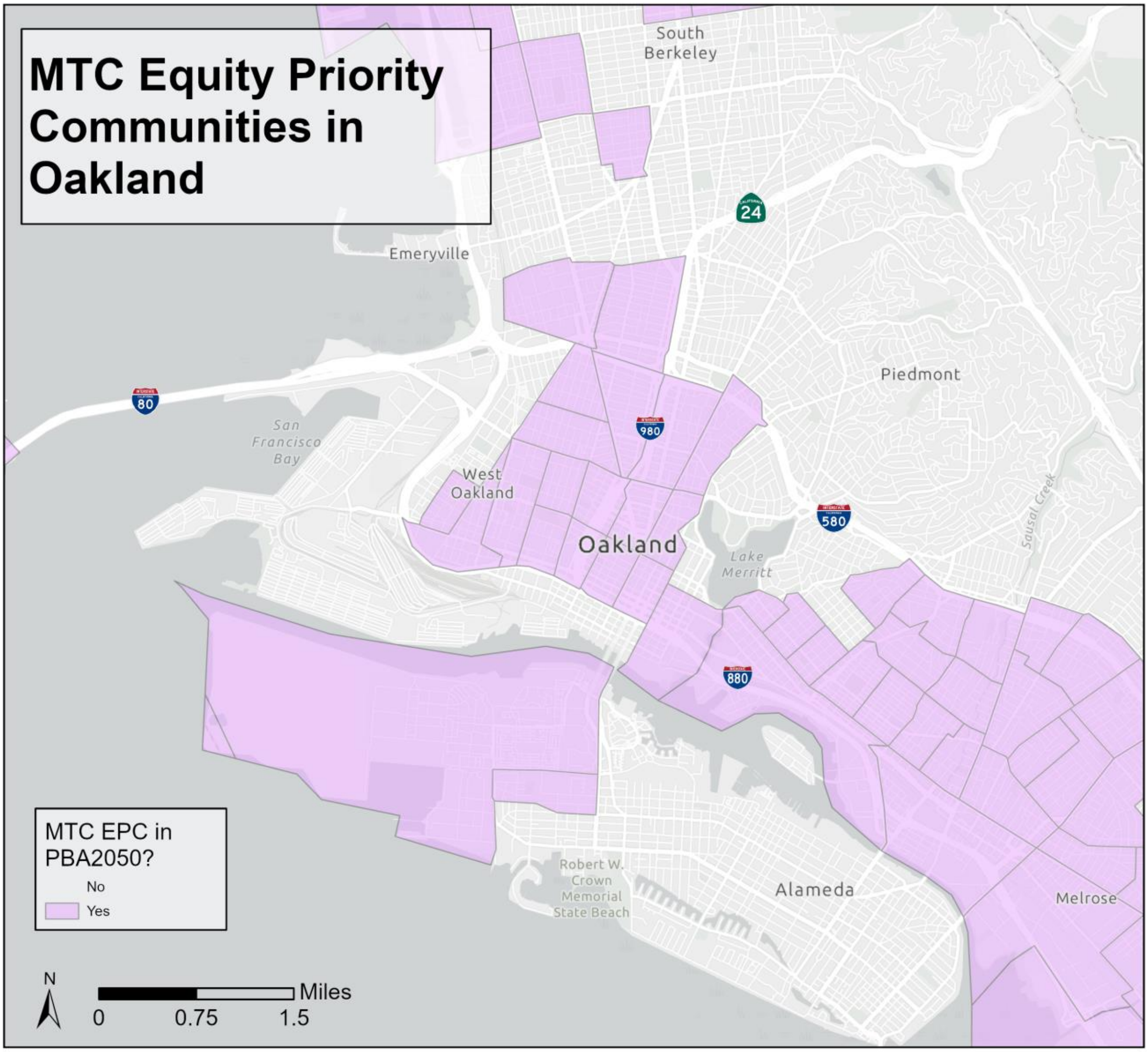
- US Census Data. Census block groups for the entire United States are available through Esri's Living Atlas, a part of the ArcGIS suite. These block groups were added into the project, and only the block groups in each city that intersected an obstruction were selected. Each selection of block groups was exported as its own new feature class, where it could be enriched with census data for analysis. Population density and median household income are two census-level data points that this project will look at to help understand both where obstructions take place and what these places are like.

- MTC Equity Priority Community Status. As part of Plan Bay Area 2050, the Metropolitan Transportation Commission (MTC), the Metropolitan Planning Organization (MPO) for the San Francisco Bay Area designates specific census tracts as Equity Priority Communities (EPCs).

EPCs are defined as tracts with "a significant concentration of underserved populations, such as households with low incomes and people of color."[117] MTC makes this data available as a shapefile with multiple attributes. For this project, whether a specific tract is designated as an EPC in Plan Bay Area 2050 was chosen as the primary focus. Cross-referencing obstructions with the EPC layer helps to create a clearer understanding as to whether obstructions are more frequently occurring in areas already determined to face structural and systematic hardships.

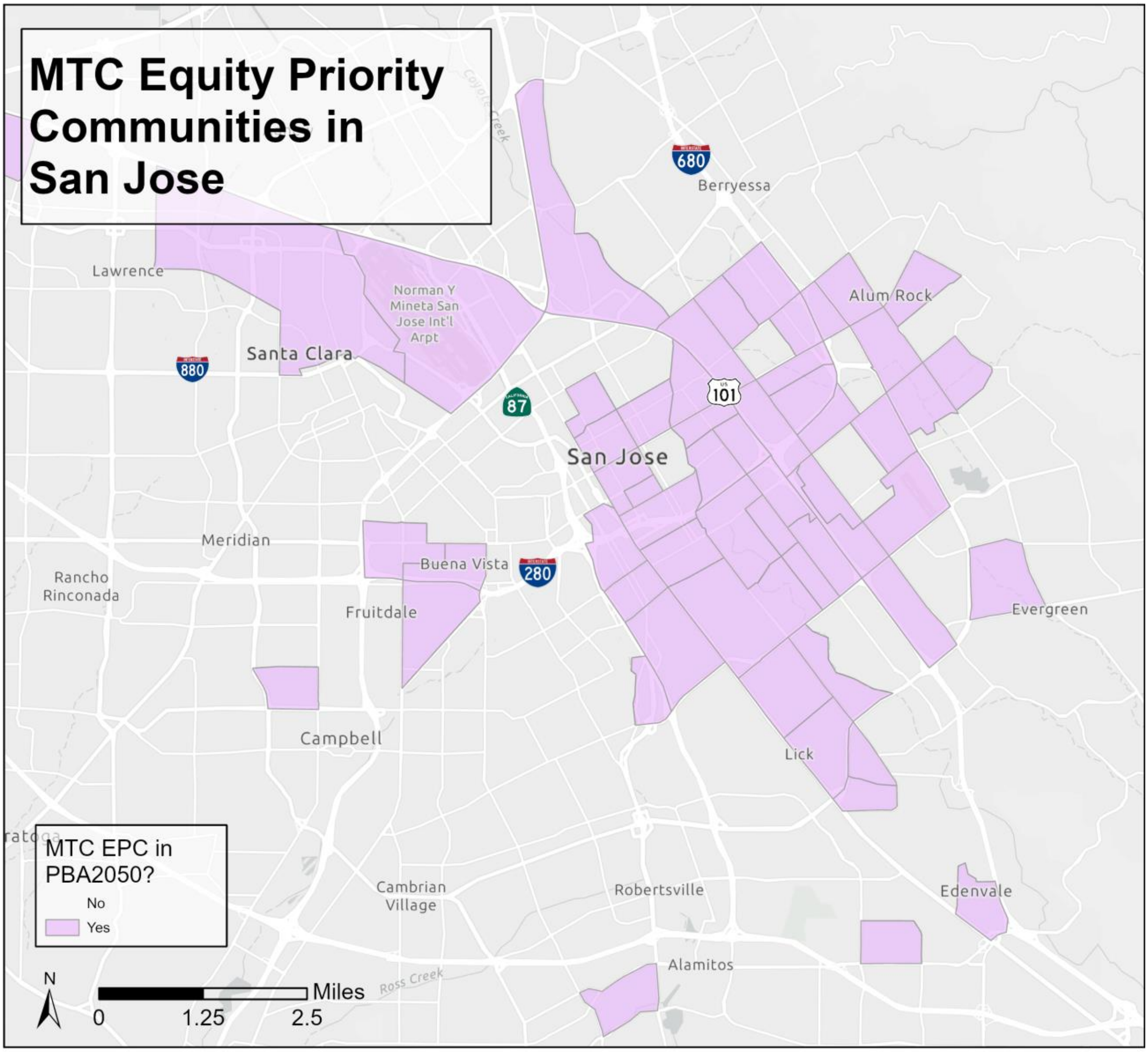
117. Metropolitan Transportation Commission, "Equity Priority Communities". Accessed September 11th, 2023, https://mtc.ca.gov/planning/transportation/access-equity-mobility/equity-priority-communities

Figure 3.7: Map of MTC Equity Priority Communities in Oakland



Data Source: Metropolitan Transportation Commission

Figure 3.8: Map of MTC Equity Priority Communities in San José



Data Source: Metropolitan Transportation Commission

Introduction

In the absence of an existing dataset to analyze, completion of this project required the creation of a dataset of bike lane obstructions in both study cities. Collecting the data for this project was somewhat irregular, as trips into the field to collect data yielded varying levels of success. It was possible to spend an hour out collecting data without recording a single obstruction. Alternatively, a 15-minute commute could generate 10 or more obstructions. In the following chapter, the existing data will be analyzed in reference to the variables defined in Chapter 3e. These variables were determined throughout the data collection period, as patterns in obstruction frequency became clear.

There is an imbalance in the data set between obstructions recorded in Oakland and obstructions recorded in San José. Efforts were made to distribute the collection time as equally as possible between the two cities. San José obstructions were recorded on weekdays (typically Tuesday through Thursday) and Oakland obstructions were recorded on Fridays and weekends. Some of the San José-specific methodology may indicate a reason for the disparity in obstructions - the high frequency of unbundled yard waste and garbage can-related obstructions may have contributed to recording close to twice as many obstructions in San José as compared to Oakland.

The data collection process could have been ongoing if not for deadlines to begin data analysis and writing of this report. Efforts were made to collect 100 obstructions minimum in each study city, however only 86 obstructions were recorded in Oakland due to the stated time constraints.

Chapter 4a: Obstructions by Count

Obstructions in the bike lane in Oakland and in San José were recorded over a 16-month period. A total of 226 obstructions were recorded for this report, with 86 of those in Oakland and the remaining 140 in San José. At times, a recorded obstruction contained multiple objects that simultaneously obstructed the bike lane. For this report, these instances will be referred to as “multiple obstructions”. In Oakland, multiple obstructions occurred 4.65 percent of the time (n=4). In San José, multiple obstructions occurred 26.4 percent of the time (n=37), or 5.7 times as often as in Oakland.

The data shows that multiple obstruction incidents in San José are much more common than in Oakland. The mean number of objects in each recorded obstruction in San José was 1.99. When only examining multiple obstructions, the mean number of objects rose to 4.75. In Oakland, the mean number of objects in each obstruction was 1.05, with 2.25 as the mean when only examining multiple obstructions. The following map shows obstructions by count in San José, with larger dots corresponding to obstructions with greater numbers of obstructing objects. Of the 37 multiple obstruction incidents that occurred in San José, nearly one-fourth contained seven or more objects, with a maximum of 17 recorded objects in a single obstruction incident.

Figure 4.1: Distribution of Multiple Obstruction Incidents in San José

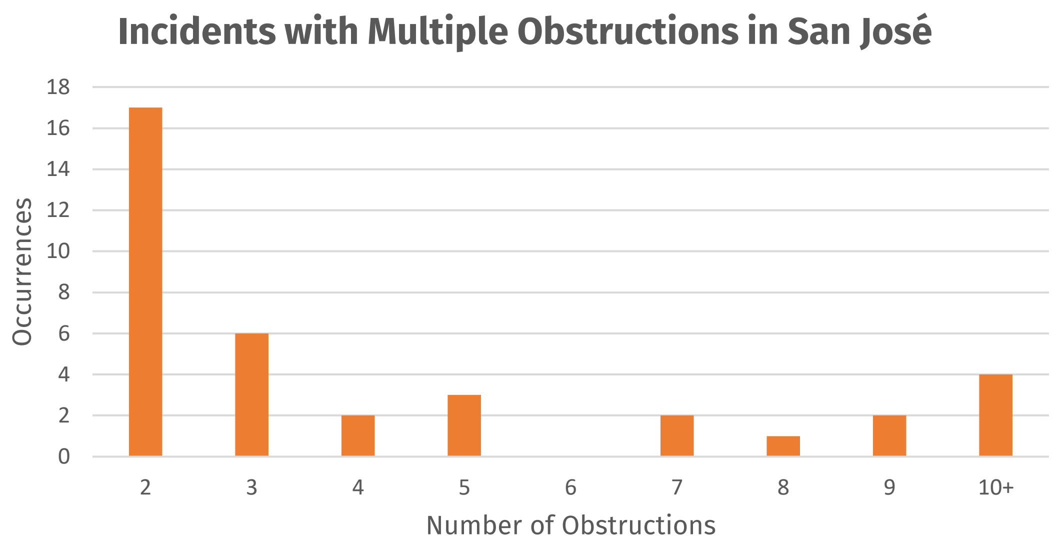
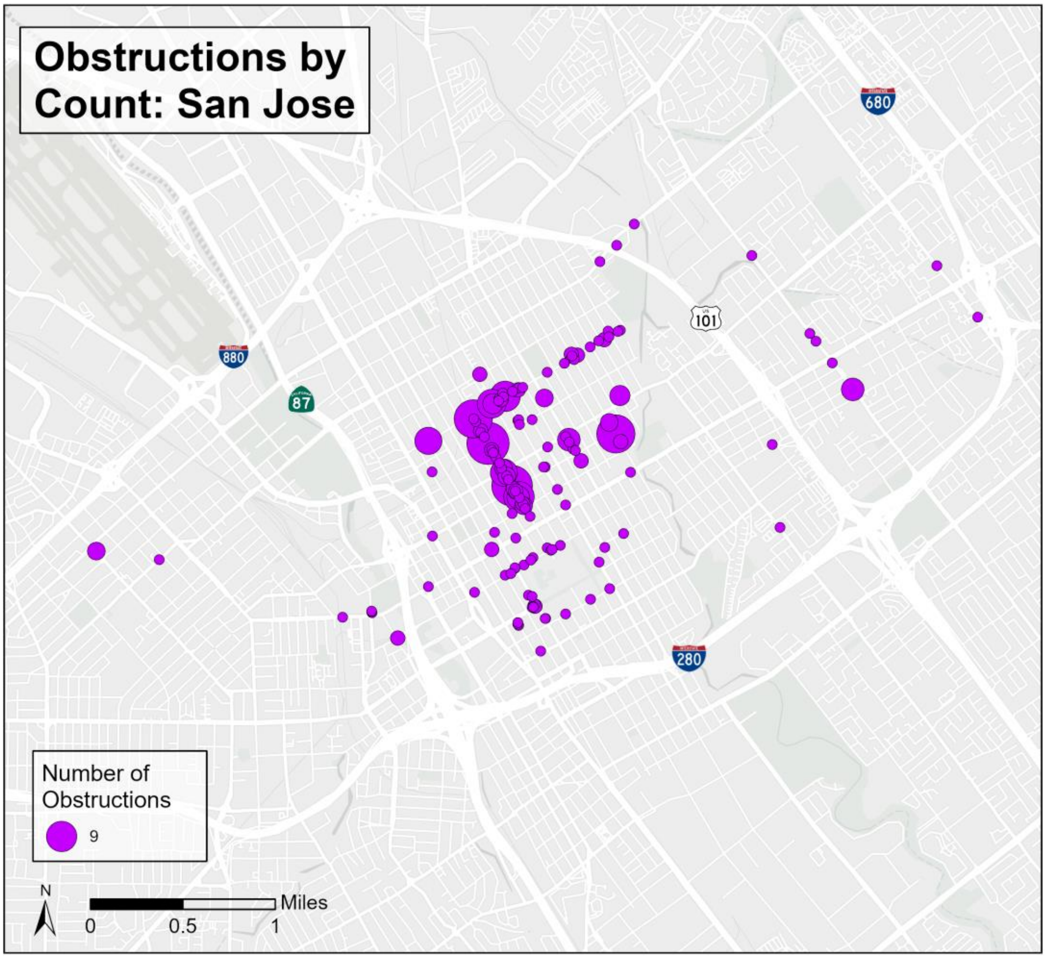


Figure 4.2: Map of Obstructions by Count in San José



Data Source: Author-Collected Obstruction Data, Esri

Data Source: Author-Collected Obstruction Data, Esri

Figure 4.3: Inset Map of Obstructions by Count North of Downtown San José

Chapter 4b: Obstructions by Bikeway Classification

Does a specific bikeway class have an impact on the frequency of obstructions? Obstructions were recorded in Class II (standard painted or buffered painted) bike lanes as well as Class IV (protected) bike lanes. 58 of 86 (67.5 percent) of obstructions recorded in Oakland were found in Class II bike lanes. In San José, this percentage remained nearly identical – 93 out of 140 recorded obstructions were in Class II bike lanes (66.5 percent).

Figure 4.1, on the previous page, shows a breakdown of multiple obstruction incidents in San José,
sorted by the number of overall obstructions. No similar chart was produced for Oakland due to the relative scarcity of multiple obstruction incidents. The sample size was too small (n=4). Figure 4.2 on the following page, shows the spatial location of all obstructions by count in San José, with larger circles symbolizing clusters of multiple obstructions – the largest circles represent the obstructions with the most objects.

Figure 4.2, on the previous page, shows a cluster of multiple obstructions with high counts along North 7th Street just north of Downtown San José in the Horace Mann neighborhood. Three of the four multiple obstruction incidents with double-digit obstructions occurred on North 7th Street, with all these obstructions being of the Dumpster/Garbage Can variety. Additionally, out of the 37 multiple obstruction instances recorded in San José, 32 (86.5 percent) of these were Dumpster/Garbage Can obstructions. The data shows that when obstructions are clustered together in high numbers, they are likely to be garbage cans or dumpsters obstructing the bike lane.

Figure 4.3 at left, shows in detail the multiple obstruction cluster along the North 7th Street Corridor, from St. John Street to Empire Street. A second, smaller cluster exists along the Class II bike lane on Empire, running from North 7th Street east to North 13th Street.

Table 4.1: Obstruction Percentages by Bikeway Class and Total Centerline Miles of Bikeway

Study City	Square Mileage	% of Recorded Obstructions in Class II Bike Lanes	% of Recorded Obstructions in Class IV Bikeways	Existing Centerline Miles of Class II Bike Lanes	Existing Centerline Miles of Class IV Bikeways
Oakland	55.93	67.5	32.5	90.67	2.69
San José	178.26	66.5	33.5	342.28	29.15

About two-thirds of recorded obstructions in each city were in Class II bike lanes, meaning that obstructions were found in Class II bike lanes at a rate of two to one when compared to Class IV bikeways. The data points to Class IV bikeways as less frequently obstructed in the scope of this study.

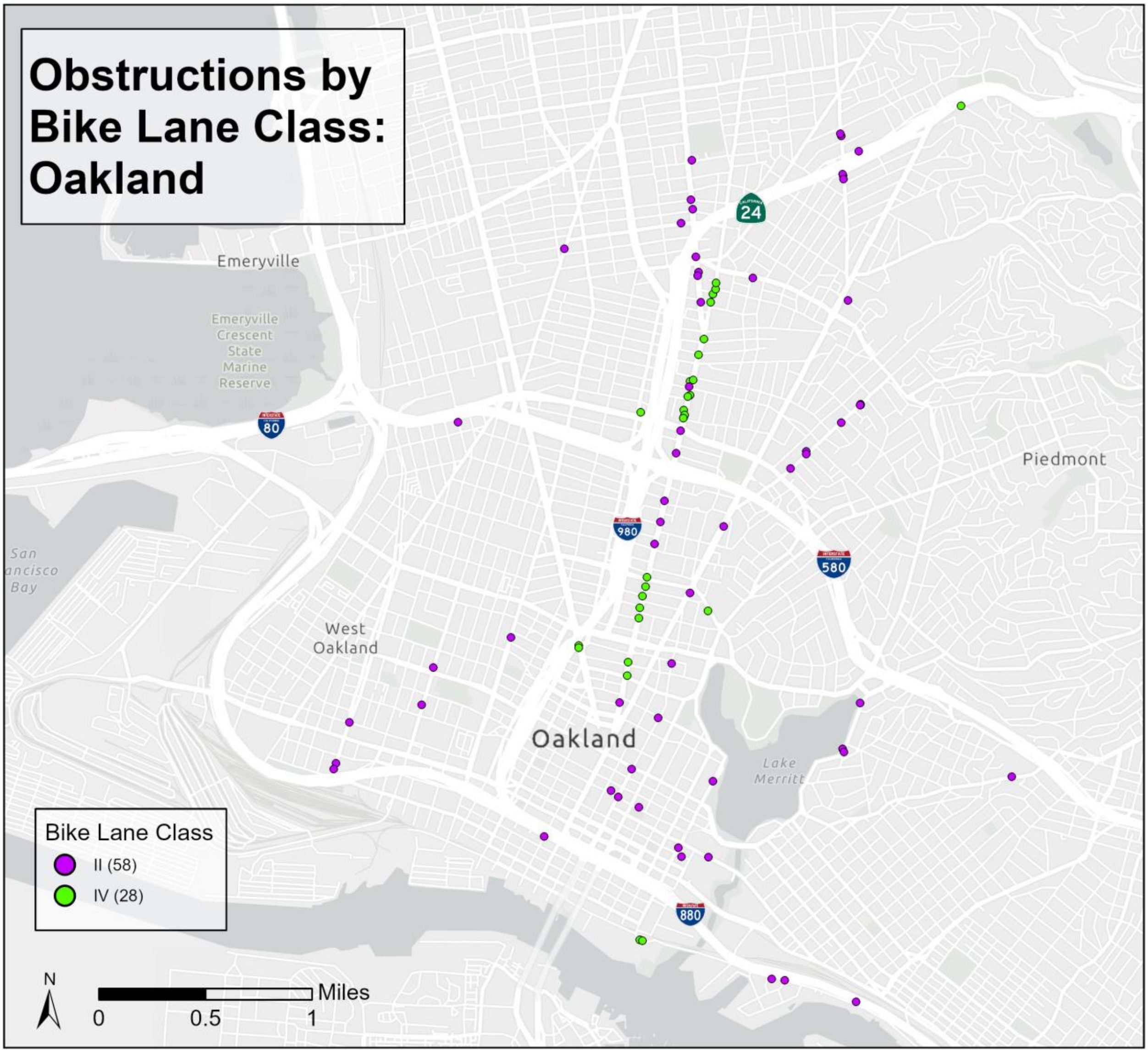
The fact that this percentage held constant across both study cities is notable. There are several disparities between the two study cities that might have an impact on the percentage of obstructions in each bikeway class. First, San José (178.26 square miles) is over three times as large as Oakland (55.93 square miles). Second, San José has over ten times as many centerline miles of existing Class IV bikeway (29.15) when compared to Oakland's 2.69 miles. Existing literature cited in this report shows that Class IV bikeways are the safest form of bicycle infrastructure that a city can choose to implement, and both study cities are focusing on developing their network of protected bike lanes. The data obtained in this report shows that protected bike lanes are also less likely to be obstructed than bike lanes that are only separated from traffic with paint. See Table 4.1 above for detailed information on the breakdown of each city's square mileage, obstruction percentages by bike lane classification, and existing centerline miles of Class II and Class IV bikeways.

In both study cities, bike lane obstructions are less often found in Class IV bikeways when compared to Class II bike lanes. This holds true despite the difference in overall square mileage and centerline mileage of Class IV bikeway in each study city. Figures 4.4 and 4.5, on the following pages, show the spatial location of obstructions by bikeway class in each of the two study cities. Telegraph Avenue accounted for 22 out of 28 obstructions in Class IV bikeways – this is Oakland's first major protected bikeway and runs through the heart of Uptown Oakland and Temescal. It is important to note that while the Telegraph bikeway is completely open to bicycle traffic, it is still under construction. Flexposts and quick-build elements are being replaced with hardscaped concrete barriers on a block-to-block basis. Once complete it would be worth revisiting obstructions on Telegraph to see if the fully hardscaped elements do a better job of keeping vehicles out of the bike lane.

Notably, the Telegraph bikeway reverts to Class II from 28th Street to 37th Street. All five obstructions recorded in this segment were vehicles parked in the bike lane.

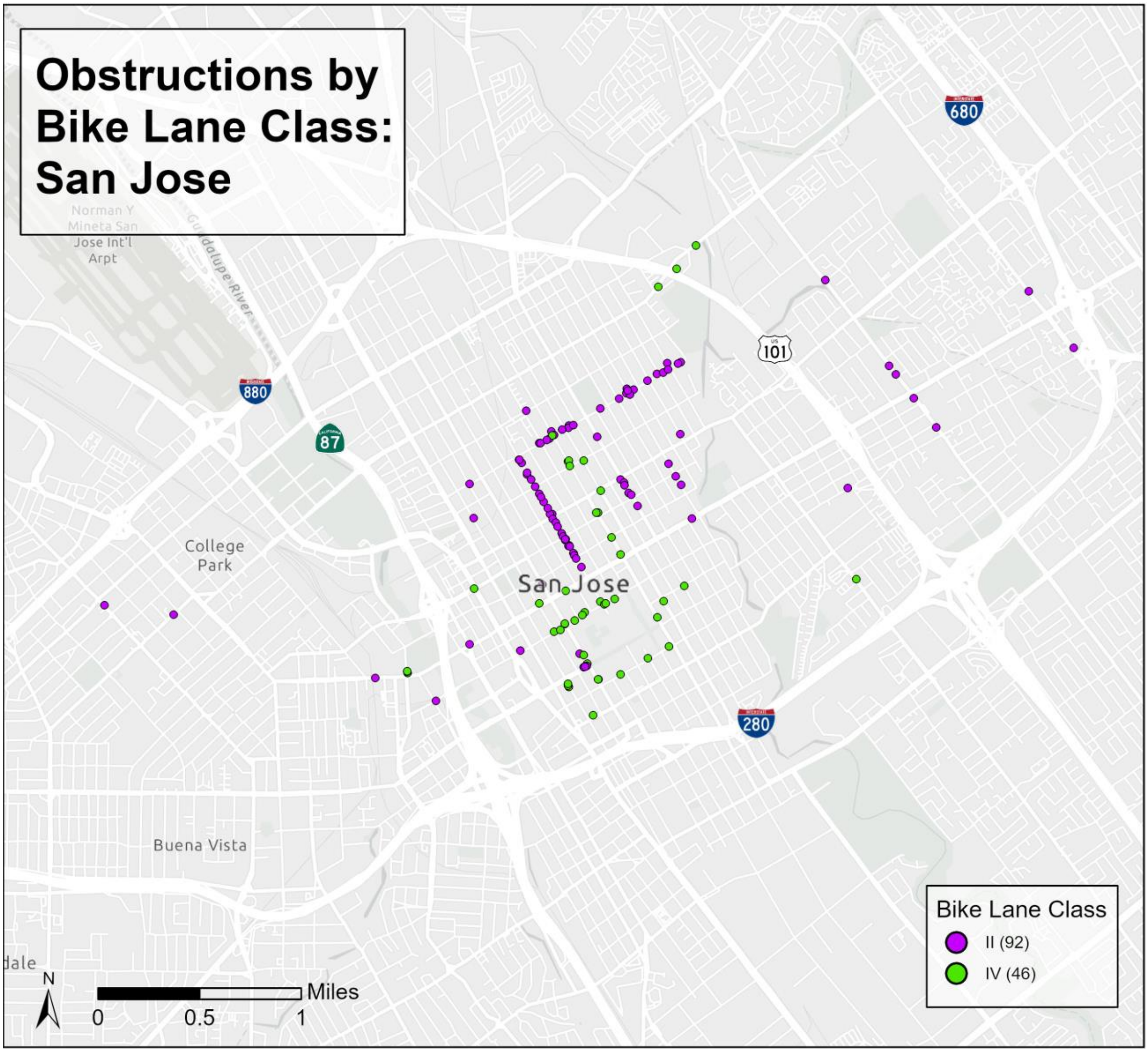
This percentage dropped from 100 percent to 71.5 percent in the protected segments of Telegraph. While the Class II and Class IV segments of Telegraph were both often found to be obstructed, obstructions in the Class IV segments were less likely to be from cars of any type. In San José, this number was much lower – 28.2 percent of obstructions in Class IV bikeways were from cars of any type.

Figure 4.4: Map of Obstructions by Bike Lane Class in Oakland



Data Source: Author-Collected Obstruction Data, Esri

Figure 4.5: Map of Obstructions by Bike Lane Class in San José



Data Source: Author-Collected Obstruction Data, Esri

Chapter 4c: Obstructions by Type (and Bikeway Class)

Are certain types of obstructions more common in specific types of bike lanes? When a Class IV bikeway is obstructed, the leading cause varies by city. In Oakland, the most common obstruction in a Class IV bikeway was a Parked Private Vehicle (n=10), followed by a Work Vehicle (n=5). In San José, the most common cause of an obstruction in a Class IV bikeway was Unbundled Yard Waste (n=14), followed by Parked Private Vehicle (n=10).

Vegetation/Water obstructions were only found in Class IV bikeways – their protected nature can make them more susceptible to these sort of obstructions. Again, while the sample size is small, a curb-separated portion of the Telegraph Avenue bike lane in Oakland was completely flooded due to poor drainage after a rainstorm. The water was trapped in the lane by the combination of a raised bus island and the sidewalk. This was completely impassable and caused a dismount to proceed down the street.

Class IV obstructions, in general, can be harder to avoid. While obstructions in Class II bike lanes can often by bypassed by temporarily mixing with automobile traffic, Class IV protected bikeways often leave the rider nowhere to go when faced with an obstruction due to barriers on both sides. An argument can be made that dismounting and temporarily walking is safer and a more desirable option than being forced into a car travel lane.

A basic visual analysis of each Class IV obstruction photograph found that 53 percent of these obstructions (38 out of 72) would have reasonably required the rider to dismount to proceed along through the bike lane. Each photo was examined based on the obstruction type, the estimated percentage of the bike lane they were obstructing, and the size of the Class IV bikeway itself. If the obstruction appeared to take up greater than 50 percent of the bikeway, it was determined to be impassable. If the obstruction took up less than 50 percent of the bikeway, it was determined to be passable. The minimum width of a Class IV bikeway according to the California Department of Transportation is five feet (for one-way travel when adjacent to a roadway, but seven feet is preferred. With many bicycle handlebars being two to two and a half feet in width, the 50 percent obstruction criteria was determined given the minimum width of a Class IV bikeway.

The percentage of Class IV obstructions deemed impassable using the provided methodology was much higher in Oakland compared to San José. 75 percent of Oakland Class IV obstructions (21 out of 28) were deemed impassable. 29.5 percent of San José Class IV obstructions (13 out of 44) were deemed impassable.

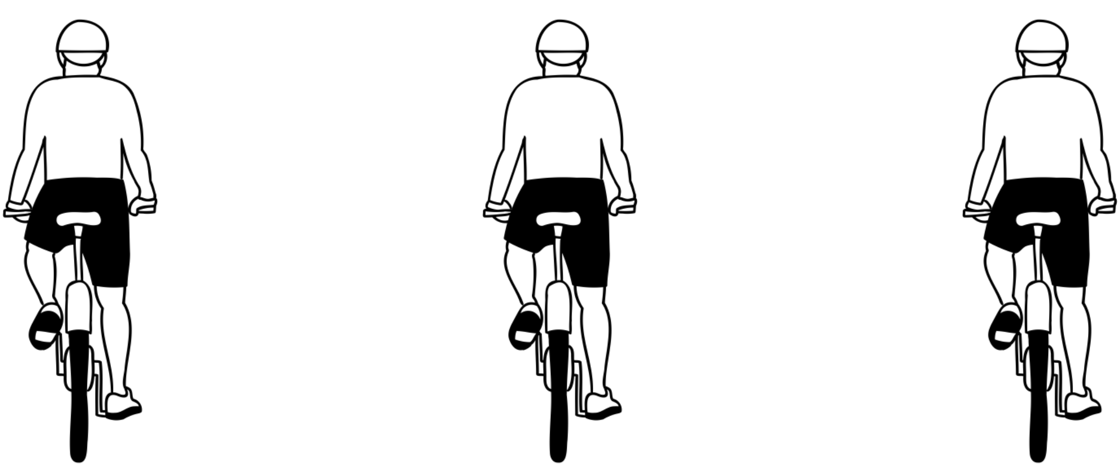
Initially, the disparity between cities was thought to be due by the prevalence of shared scooter obstructions in San José. This obstruction type was not found in Oakland, presumably due to lock-to requirements wherein scooters must be locked to a bike rack for a user to end their trip. That said, there were more impassable obstructions in Oakland than San José, regardless of the lock-to requirements.

Being locked to the rack is designed to prevent scooters from tipping over and falling into the bike lane, among other places. The data collected for this project shows that these lock-to requirements are effective, at least in the context of keeping shared scooters out of protected bike lanes. Scooters accounted for 14 out of the 44 Class IV obstructions in San José, and all 14 of these obstructions were narrow enough that the rider could still somewhat easily pass by the obstruction provided they saw it in advance. That said, it speaks to how bicycle infrastructure is viewed within the hierarchy of the transportation modes that a discussion of 'which method of avoiding an obstruction is preferable' could even take place. It is the opinion of the author that a car travel lane facing regular obstructions could and would likely be dealt with without forcing a driver to either temporarily exit their car, or proceed in a manner that places them at increased risk of injury.

See Table 4.2 below for a complete breakdown of Class IV bikeway obstructions by type in both study cities.

Table 4.2: Class IV Bikeway Obstructions by Type, Oakland and San José

Obstruction Type	Oakland	San José
Construction/Street Equipment	3	0
Delivery Vehicle	3	1
Dumpster/Garbage Can	4	8
Parked Vehicle (Private)	10	10
Police Vehicle	2	2
Shared Scooter	0	14
Vegetation/Water	1	2
Unbundled Yard Waste	0	7
Work Vehicle	5	0
TOTAL	**28**	**44**



Source: Softscape for the Noun Project, used under Creative Commons License

When a Class II bike lane is obstructed, the leading cause again varies by city. In Oakland, the most common obstruction in a Class II bike lane was again Parked Private Vehicle (n=27), followed by a Delivery Vehicle (n=13). In San José, the most common cause of an obstruction in a Class IV bikeway was Dumpster/Garbage Can (n=50), followed by Parked Private Vehicle (n=29).

Unbundled Yard Waste, which accounted for zero obstructions in Oakland, ranked third in San José (n=23). Dumped Object accounted for 10 total Class II bike lane obstructions, with five in each city, but zero total Class IV obstructions of this type were spotted while collecting data. While the sample size is small, this does point to the ability of Class IV bikeways to resist larger obstructions.

See Table 4.3 below for a complete breakdown of Class II bike lane obstructions by type in both study cities. Additionally, Table 4.4 on the following page displays obstructions by type in both cities, regardless of bikeway class.

Table 4.3: Class II Bike Lane Obstructions by Type, Oakland and San José

Obstruction Type	Oakland	San José
Business Equipment	2	0
Construction/Street Equipment	2	6
Delivery Vehicle	13	3
Dumped Object	5	5
Dumpster/Garbage Can	3	43
Parked Vehicle (Private)	27	18
Police Vehicle	2	0
Shared Scooter	0	0
Unbundled Yard Waste	0	16
Vegetation/Water	0	0
Work Vehicle	4	3
TOTAL	**58**	**94**

Table 4.4: Total Obstructions by Type, Oakland and San José

Obstruction Type	Oakland	San José	Total
Parked Vehicle (Private)	37	28	65
Dumpster/Garbage Can	7	51	58
Unbundled Yard Waste	0	23	23
Delivery Vehicle	16	4	20
Shared Scooter	0	14	14
Work Vehicle	9	3	12
Construction/Street Equipment	5	6	11
Dumped Object	5	5	10
Police Vehicle	4	2	6
Vegetation/Water	1	2	3
Business Equipment	2	0	2

Table 4.5: Class IV Obstructions by Passability, Oakland and San José

Class IV Obstructions	Oakland	San José	Total
Impassable Without Dismounting	21	13	34
Passable Without Dismounting	7	31	38
Total Class IV Obstructions	28	44	72
Percentage Requiring Dismount	75%	30%	53%

Figure 4.6: Class IV bikeway obstruction on Telegraph Avenue in Oakland.

Figure 4.7: Class IV bikeway obstruction on Telegraph Avenue in Oakland.

Chapter 4d: Obstructions by Base Zoning Type

Does land use have an impact on the frequency of bike lane obstructions? In both cities, the base zoning type at the location of each obstruction was analyzed. For this project, base zoning acts as a stand-in for land use. Both cities clearly delineate prescribed uses for every parcel within their city limits in their respective municipal codes. The specific zoning nomenclature used in Oakland and San José is not identical, however, the underlying land uses are. In addition to examining city-specific zoning types, this analysis also derives higher-level simplified zoning types for each city to draw a more direct comparison between study cities.

In Oakland, 56 out of 87 obstructions (64.3 percent) took place in zoning districts that could be categorized as commercial. These specific districts include the CBD (Central Business District) zone, CC (Community Commercial) zone, CN (Commercial Neighborhood) zone, among others. The CN zone was the most frequently obstructed, with 30 total obstructions recorded during the data collection period. The City of Oakland Planning Code describes the intent of the CN zone as "to create, preserve, and enhance mixed use neighborhood commercial centers...typically characterized by smaller scale pedestrian oriented, continuous and active store fronts."[118] It is somewhat ironic that a district focused on pedestrian-oriented, smaller-scale uses is the leader in bikeway obstructions. It is not a big reach to guess that many of those who patronize these businesses may arrive by bicycle. The second and third most frequently obstructed zones in Oakland were the CBD and CC zones, with 13 and 11 recorded obstructions, respectively.

Beyond obstructions within commercial zones, 24 out of 87 (27.5 percent) of obstructions recorded in Oakland took place in districts that could be categorized as residential in nature. These specific districts include the HBX (Housing-Business Mix) zone, the R-80 (High-Rise Apartment) zone, the RM (Residential Mixed Housing) zone, and the S-15 (Transit-Oriented Development) zone. The RM zone was the most frequently obstructed residential zone, with 11 total obstructions recorded. This zone is described in the planning code as "residential areas typically located near the City's major arterials and characterized by a mix of single-family homes, townhouses, small multi-unit buildings, and neighborhood businesses where appropriate."[119] It is notable that the residential districts where obstructions occurred are those where uses are mixed, and housing is built at greater densities.

The data shows that just under 92 percent of recorded obstructions took place in either generally commercial or generally residential base zoning types.

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118. *City of Oakland Zoning Code*, Chapter 17.33.010. Accessed October 7th, 2023, https://library.municode.com/ca/oakland/codes/planning_code?nodeId=TIT17PL_CH17.33CNNECECOZORE_17.33.010TIINDE

119. *City of Oakland Zoning Code*, Chapter 17.17.010. Accessed October 7th, 2023, https://library.municode.com/ca/oakland/codes/planning_code?nodeId=TIT17PL_CH17.17RMMIHOTYREZORE

These are land use types that typically generate more car traffic and act as stronger magnet sites for people to visit. The findings of this study point to the impacts of land use on bike lane obstructions in as much as obstructions were more frequently recorded in areas in which space was being competed for more aggressively.

Bustling commercial districts and mixed-use, higher-density residential districts typically generate more traffic than lower-density residential or industrial zones. With more car traffic comes a higher frequency of bike lane obstructions, especially in areas where parking is at a premium. 45 out of 56 obstructions (80 percent) in commercial zones were related to parked cars of any type – be they private vehicles, police vehicles, work vehicles, or delivery vehicles. The more reason there is to be in a neighborhood, the more likely a bike lane obstruction is to occur. In residential districts, where the general demand for space is often less than commercial districts, 15 out of 24 obstructions (62.5 percent) of obstructions were due to vehicles of any type. Vehicle obstructions in total in Oakland accounted for 70 percent of all obstructions, putting particular importance on finding more curb space for competitors in commercial areas. Vehicle-based obstructions in these zones were more common than in Oakland as a whole.

See below and on the following page for tables that display the complete list of obstructions by base zoning type in Oakland, as well as obstructions by a more simplified zoning type. Figure 4.8 on the following page displays the spatial location of obstructions by simplified zoning type.

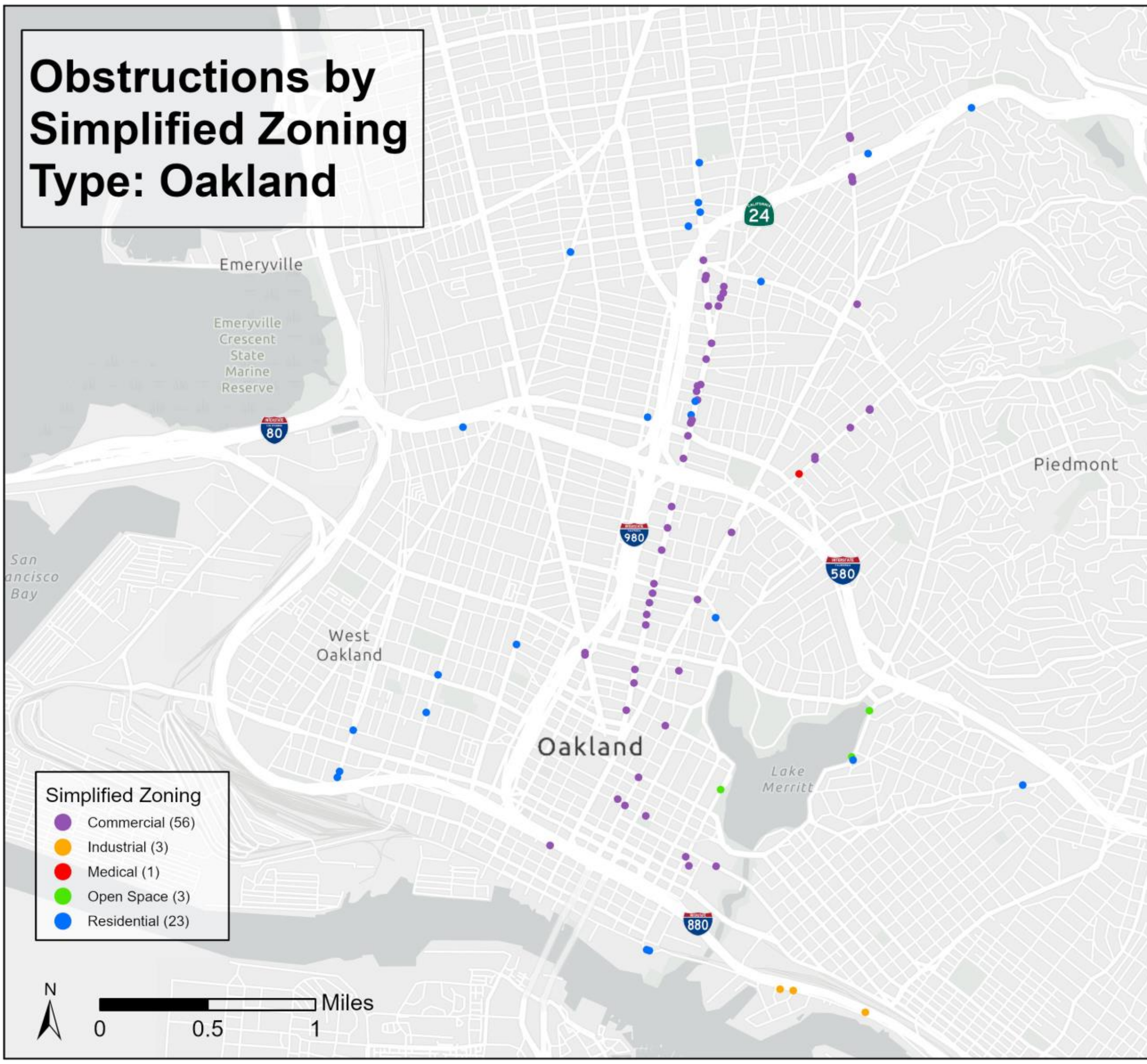
Table 4.6: Obstructions by Base Zoning Type, Oakland

Base Zoning	Description	Count
C-40	Community Thoroughfare Commercial	1
CBD	Central Business District	13
CC	Community Commercial	11
CN	Commercial Neighborhood Center	30
D-KP	Kaiser Permanente District	1
HBX	Housing and Business Mix	2
M-40	Heavy Industrial	3
OS	Open Space	3
R-80	High-Rise Apartment Zone	2
RD	Residential Detached Unit	1
RM	Residential Mixed Housing	11
RU	Urban Residential	3
S-2	Civic Center	1
S-15	Transit Oriented Development	5

Table 4.7: Obstructions by Simplified Zoning Type, Oakland

Simplified Zoning	Count
Commercial Uses	56
Industrial Uses	3
Medical Uses	1
Open Space	3
Residential Uses	24

Figure 4.8: Map of Obstructions by Simplified Zoning Type in Oakland



Data Source: Author-Collected Obstruction Data, Esri, City of Oakland Open Data Portal.

The impacts of land use on bike lane obstructions in San José are even stronger than in Oakland. In San José, 85 out of 140 obstructions (60.7 percent) occurred in zoning districts that can be characterized as having residential land uses. As density of these residential districts increased, so did the number of obstructions. There were 18 recorded obstructions in the R-1-8 zone (up to eight dwelling units *per acre*), 25 recorded obstructions in the R-2 zone (up to two dwelling units *per lot*), and 38 recorded obstructions in the R-M zone (multiple dwelling units *per lot*). Of these 85 residential obstructions, 59 were due to dumpsters, garbage cans, or unbundled yard waste being placed in the bike lane. The data collected in San José shows that as housing density increases, the likelihood of bike lane obstructions due to increased competition for curb space increases. With more housing units comes more garbage cans, recycling bins, and yard waste.

While one might expect that increased residential density would also lead to increased delivery vehicle obstructions, the data did not show this to be a major issue in San José. One possible explanation is due to the temporal nature of delivery vehicle obstructions - delivery vehicles are only ever obstructing the bike lane for short periods of time. A delivery may last anywhere from 15 seconds to a minute before the vehicle moves on to the next stop on their route. A garbage can or yard waste obstruction can last for hours if not days. 31 of the 74 (41.89 percent) Dumpster/Garbage Can or Unbundled Yard Waste obstructions recorded in San José were on the day before (n=1) or the day after (n=30) scheduled collection.

In Oakland, Commercial land uses were the most common simplified zoning type in which bike lane obstructions were spotted. In San José, Commercial uses were second to Residential uses, with a total of 28 obstructions recorded in Commercial zoning areas. A possible explanation for this discrepancy between cities is their layout – San José has a significant residential accumulation only one block north of Downtown – the Hensley, Horace Mann, and Julian-St. James neighborhoods start right above Santa Clara Street. Oakland's downtown is separated further from its residential neighborhoods, especially to the north and to the west. The downtown traffic spills into residential neighborhoods much quicker in San José.

Finally, San José saw 14 obstructions in the Public/Quasi Public (PQP) base zoning. The parcels with this zoning where bike lane obstructions typically occurred were part of San José State University (SJSU). The SJSU campus occupies 154 acres in Downtown San José[120] and has a student body of over 32,000.[121] The university has Class IV bikeways on all four of its border streets – San Fernando Street, 10th Street, San Salvador Street, and 4th Street. The Class IV bikeways seem to do a good job reducing vehicle obstructions around the university perimeter.

120. San José State University "About SJSU," Accessed October 7th, 2023, https://www.sjsu.edu/global/about
121. San José State University "Fall 2022 Student Quick Facts," Accessed October 7th, 2022. https://analytics.sjsu.edu/t/IRPublic/views/student_quckfact/StudentQuickFacts

Only five of the 14 PQP obstructions were due to private vehicles, and only four of these five were on the SJSU perimeter. The Class IV bikeways here are particularly susceptible to Shared Scooter obstructions – six of the 14 obstructions in the PQP zone were due to Shared Scooters. For reference, the City of San José issued permits to two scooter operators for the 2022-2023 permit cycle, and 4,000 devices is the absolute maximum number that would be in the public right-of-way at any time.

The number of cars in San José is far greater than the number of shared scooters. 2022 survey data from the American Community Survey estimates that there are approximately 328,759 occupied housing units in the City of San José. Of those housing units, only 20,751 (6.3 percent) do not have access to a vehicle. 30.4 percent of those housing units have one vehicle available; 37.3 percent have two vehicles available, and 26.0 percent have three or more vehicles available.[122] Compared to 4,000 (or less) scooters, these two modes of transportation are not comparable. The fact that scooter obstructions could outnumber car obstructions in any part of San José shows that areas such as the border of a large public university are locations that cities need to focus their attention when it comes to both bike lane obstructions and the rules for parking shared scooters.

See Table 4.8 below for the full count of Obstructions by Base Zoning type in San José, and Table 4.9 on the following page for Obstructions by Simplified Zoning Type.

122. American Community Survey, 2021 5-Year Estimates. Table S2504, Physical Housing Characteristics for Occupied Housing Units, San José city, California. Accessed October 1st, 2022, using ESRI ArcGIS Pro.

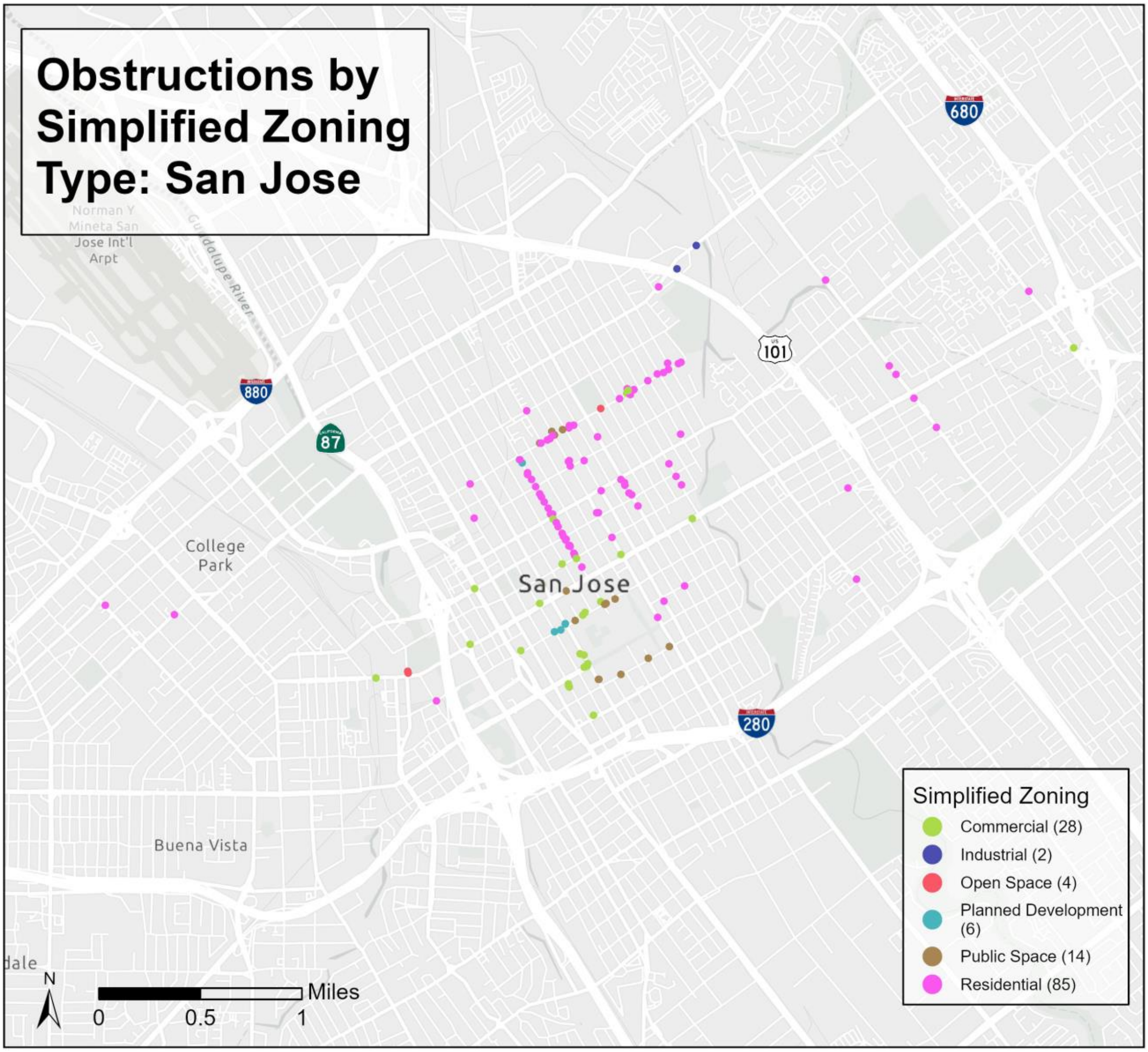
Table 4.8: Obstructions by Base Zoning Type, San José

Base Zoning	Description	Count
A(PD)	Agricultural (Planned Development)	6
CG	Commercial General	8
CN	Commercial Neighborhood	2
CP	Commercial Pedestrian	3
DC	Downtown Commercial Primary	14
LI	Light Industrial	2
MUC	Mixed Use Commercial	1
MUN	Mixed Use Neighborhood	1
OS	Open Space	4
PQP	Public/Quasi-Public	14
R-1-8	Residential - 8 Dwelling Units/Acre	18
R-2	Residential - 2 Dwelling Units/Lot	25
R-M	Residential - Multiple Dwelling Units/Lot	38
UR	Urban Residential	2
UV	Urban Village	1

Table 4.9: Obstructions by Simplified Zoning Type, San José

Simplified Zoning	Count
Commercial Uses	28
Industrial Uses	2
Open Space	4
Planned Development	6
Public Space	14
Residential Uses	85

Figure 4.9: Map of Obstructions by Simplified Zoning Type in San José



Data Source: Author-Collected Obstruction Data, Esri, City of San José Open Data Portal.

Chapter 4e: Obstructions by MTC Equity Priority Community Status

The Metropolitan Transportation Commission (MTC) is the Metropolitan Planning Organization (MPO) for the San Francisco Bay Area. An MPO is the "policy board of an organization created and designated to carry out the metropolitan transportation planning process*." MPOs are required in all urbanized areas with populations over 50,000.[123] As part of their equity platform, MTC created an indicator called Equity Priority Communities (EPC). An EPC is a "census (tract) that (has) a significant concentration of underserved populations"[124] based on demographics such as race, income, English proficiency, and households without access to a vehicle, among others.[125] MTC uses these EPC designations as a framework that lets them strategically target specific communities for transportation network improvements to "meaningfully reverse the disparities"** that have been created in the development of our transportation network. This project chose to analyze obstructions through an equity lens using the EPC criteria as it examines equity from a variety of angles – race and income, among others.

Obstructions of the bike lane are a less pervasive and destructive issue than, for example, exposure to high concentrations of PM 2.5 due to a community's proximity to a highway. That said, MTC uses its EPC framework to determine investment levels for grants designed to create a better network for things such as active transportation. Creating better infrastructure for walking, biking, and public transit is an important factor in incentivizing people to use more climate-friendly modes of transportation. Examining whether obstructions in the bike lane take place more frequently in EPCs as opposed to tracts not designated as EPCs is a way to understand whether the infrastructure for bicycling in these communities is less usable and therefore less safe. Residents of EPCs are already facing a higher share of the negative effects of the transportation system. If the bike lanes in EPCs are less usable than in other areas, it is effectively doubling down the burden on these residents. Asking those who have faced historical disparities to drive less – and then discovering that the infrastructure which would allow residents of an EPC to achieve ambitious mode share goals is less likely to be usable – is a point that this report is interested in discovering.

In Oakland, 38 out of 86 (44.2 percent) of recorded obstructions took place in EPCs. 26 of the 38 (68.4 percent) EPC obstructions were due to vehicles – parked or idling, including private vehicles, police vehicles, delivery vehicles, and work vehicles. The remaining 12 obstructions were due to inanimate objects. This distribution of obstructions resembles the greater sample, where vehicles accounted for 66 of 86 (76.7 percent) of total obstructions.

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123. United States Department of Transportation, Federal Transit Administration. "Metropolitan Planning Organization (MPO)." Accessed October 1st, 2023, https://www.transit.dot.gov/regulations-and-guidance/transportation-planning/metropolitan-planning-organization-mpo
124. "Equity Priority Communities," n.d.
125. Metropolitan Transportation Commission. "Spatial Analysis Mapping Projects," accessed October 5th, 2023, https://bayareametro.github.io/Spatial-Analysis-Mapping-Projects/Project-Documentation/Equity-Priority-Communities/

Given that MTC defines Equity Priority Communities as those that have been historically underserved by the transportation network[126], residents of EPCs are now also facing a more frequently obstructed bikeway network in Oakland. The fact that obstructions in EPCs are over twice as likely to be caused by cars as opposed to any other type of obstruction means that areas that have historically seen inequity due to the transportation network are now seeing even more of it.

See Table 4.10 below for a breakdown of Obstructions in Oakland by EPC status. Table 4.11 shows the complete breakdown of obstructions by type in Oakland Equity Priority Communities. Table 4.11 also includes a section which divides all EPC obstructions into two simplified categories – Vehicle-Related Obstructions and Non-Vehicle-Related Obstructions. In San José, the disparity between obstructions in EPCs and obstructions in non-EPC areas was even greater. 100 out of 140 (71.4 percent) recorded obstructions took place in Equity Priority Communities. Like Oakland, the breakdown of obstructions by type within EPCs in San José mirrors the larger sample.

73 out of 100 EPC obstructions (73 percent) were due to inanimate objects, mainly Dumpsters, Garbage Cans, and Unbundled Yard Waste. The remaining 27 obstructions (27 percent) were due to vehicles.

126. "Equity Priority Communities," n.d.

Table 4.10: Obstructions by MTC Equity Priority Status, Oakland

Oakland Obstructions	Count	Percentage
In EPC	38	44.19%
Not in EPC	48	55.81%
Total	86	100.00%

Table 4.11: Obstructions by Type within MTC Equity Priority Communities, Oakland

Type	Count	Percentage
Business Equipment	1	2.63%
Construction/Street Equipment	2	5.26%
Delivery Vehicle	10	26.32%
Dumped Object	4	10.53%
Dumpster/Garbage Can	5	13.16%
Parked Vehicle (Private)	10	26.32%
Police Vehicle	2	5.26%
Work Vehicle	4	10.53%
Total	38	100.00%
Vehicle	26	68.42%
Non-Vehicle	12	31.58%
Total	38	100.00%

The San José dataset does not support the claim that vehicle-related obstructions are having an outsized effect within EPCs. While obstructions within EPCs accounted for 71.4 percent of all obstructions, those obstructions were primarily due to the same causes that are found throughout all of San José.

There are several contextual reasons for why EPC obstructions were more common in San José than Oakland. Primarily, the spatial location of bikeway development in EPCs in Oakland and San José are different. Both cities do see a concentration of EPCs in their Downtown areas. Much of what is considered Downtown Oakland and Downtown San José are categorized as Equity Priority Communities. In Oakland, EPCs are primarily located West and East of Downtown. In San José, EPCs are primarily located South and East of Downtown.

The difference occurs in where the bikeways have been developed. When designing data collection routes for this project, there was a set goal to collect data in both Class II and Class IV bikeways, with an effort to keep the distribution between the two classes as balanced as possible. This was a greater challenge in Oakland, given that San José had built more lane miles of Class IV bikeway. Choosing a balanced collection route set was easier to do in San José. In Oakland, to collect enough data in Class IV bikeways, a significant amount of time had to be spent on Telegraph Avenue and Lakeside Drive. The Telegraph Avenue protected bikeway is within an EPC south of MacArthur Boulevard and outside of an EPC once north of MacArthur. South of MacArthur, the bikeway class also varies between II and IV. The Lakeside Drive protected bikeway is entirely outside of an EPC. To properly assess obstructions in Class IV bikeways in Oakland, it was necessary to spend a lot of time in non-EPC areas, especially North of Downtown in the KONO and Temescal neighborhoods. Nearly all of East Oakland below Interstate 580 is designated as an Equity Priority Community. However, this project required setting a manageable focus area for one person to collect data. Getting out to that large agglomeration of Equity Priority Communities was not feasible given the scope of this project.

Data collection took place more frequently in EPCs in San José, regardless of bikeway classification. Additionally, when looking at the data through an EPC and Zoning lens, the higher-density zoning districts in San José where obstructions were found in the greatest numbers are all within Equity Priority Communities. This was especially the case in the Hensley and Horace Mann neighborhoods.

There are three tables on the following page. Table 4.12 shows the full breakdown of obstructions in San José, separated by EPC status. Table 4.13 shows the full breakdown of obstructions by type within EPCs in San José. Table 4.13 also includes a breakdown of EPC obstructions by whether they were caused by a motor vehicle. Finally, Table 4.14 shows a complete count of total obstructions in both study cities based on their location in an Equity Priority Community. Over 60 percent of total recorded obstructions (n=138) took place within an EPC.

Table 4.12: Obstructions by MTC Equity Priority Status, San José

San José Obstructions	Count	Percentage
In EPC	100	71.43%
Not In EPC	40	28.57%
Total	140	100.00%

Table 4.13: Obstructions by Type within MTC Equity Priority Communities, San José

Type	Count	Percentage
Construction/Street Equipment	2	2.00%
Delivery Vehicle	1	1.00%
Dumped Object	3	3.00%
Dumpster/Garbage Can	41	41.00%
Parked Vehicle (Private)	23	23.00%
Police Vehicle	2	2.00%
Shared Scooter	8	8.00%
Unbundled Yard Waste	17	17.00%
Vegetation/Water	2	2.00%
Work Vehicle	1	1.00%
Total	100	100.00%
Vehicle	27	27.00%
Non-Vehicle	73	73.00%
Total	100	100.00%

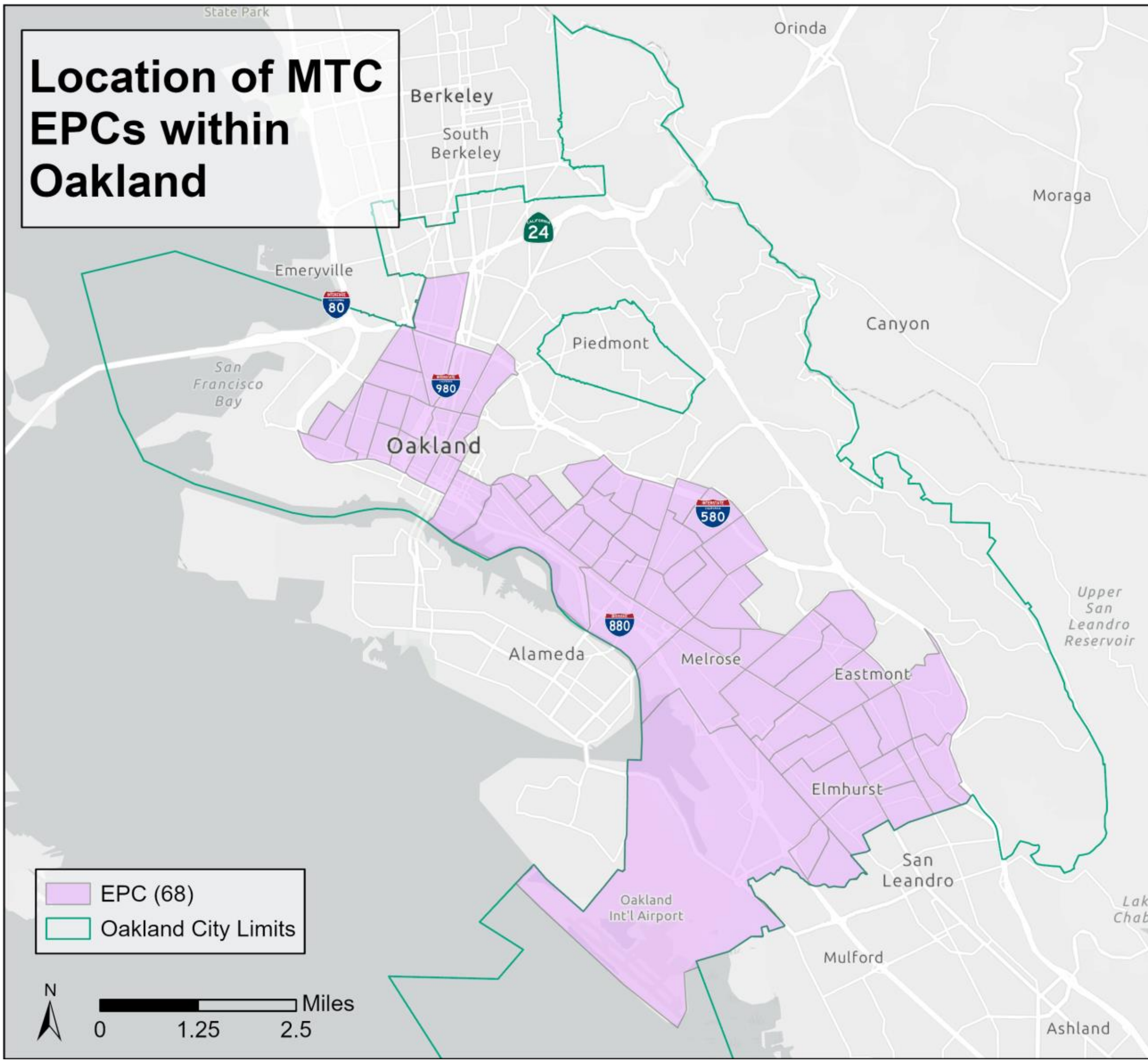
Table 4.14: Obstructions by MTC Equity Priority Status, Oakland and San José Combined

Total Obstructions	Count	Percentage
In EPC	138	61.06%
Not in EPC	88	38.94%
Total	226	100.00%

Figures 4.10 and 4.11 on pages 63 and 64, show the spatial locations of Equity Priority Communities within the entire city Limits of Oakland and San José.

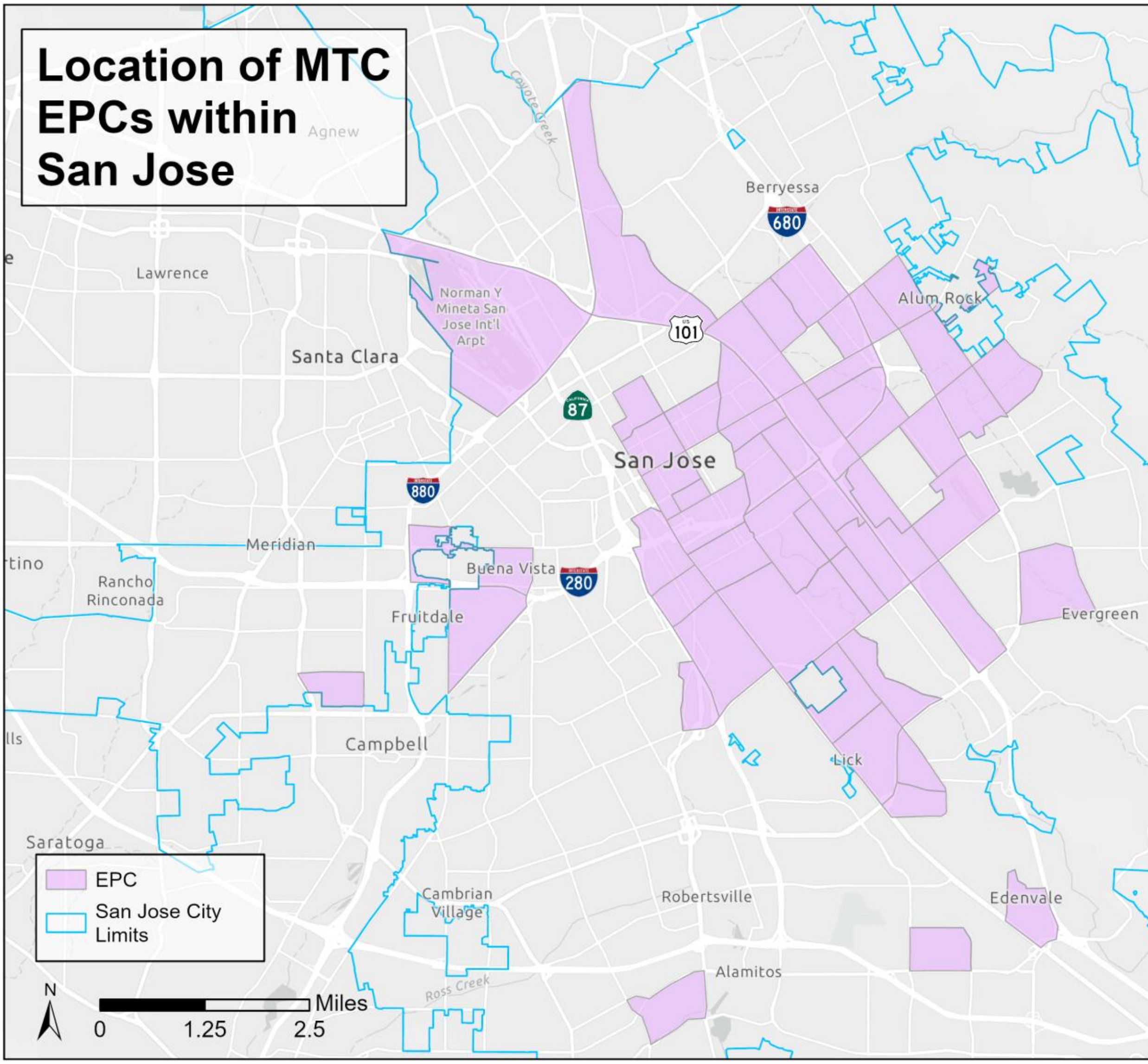
Figures 4.12 and 4.13 on pages 65 and 66, show the spatial locations of obstructions occurring within Equity Priority Communities in both study cities.

Figure 4.10: Map of Equity Priority Communities in relation to the Oakland City Limits



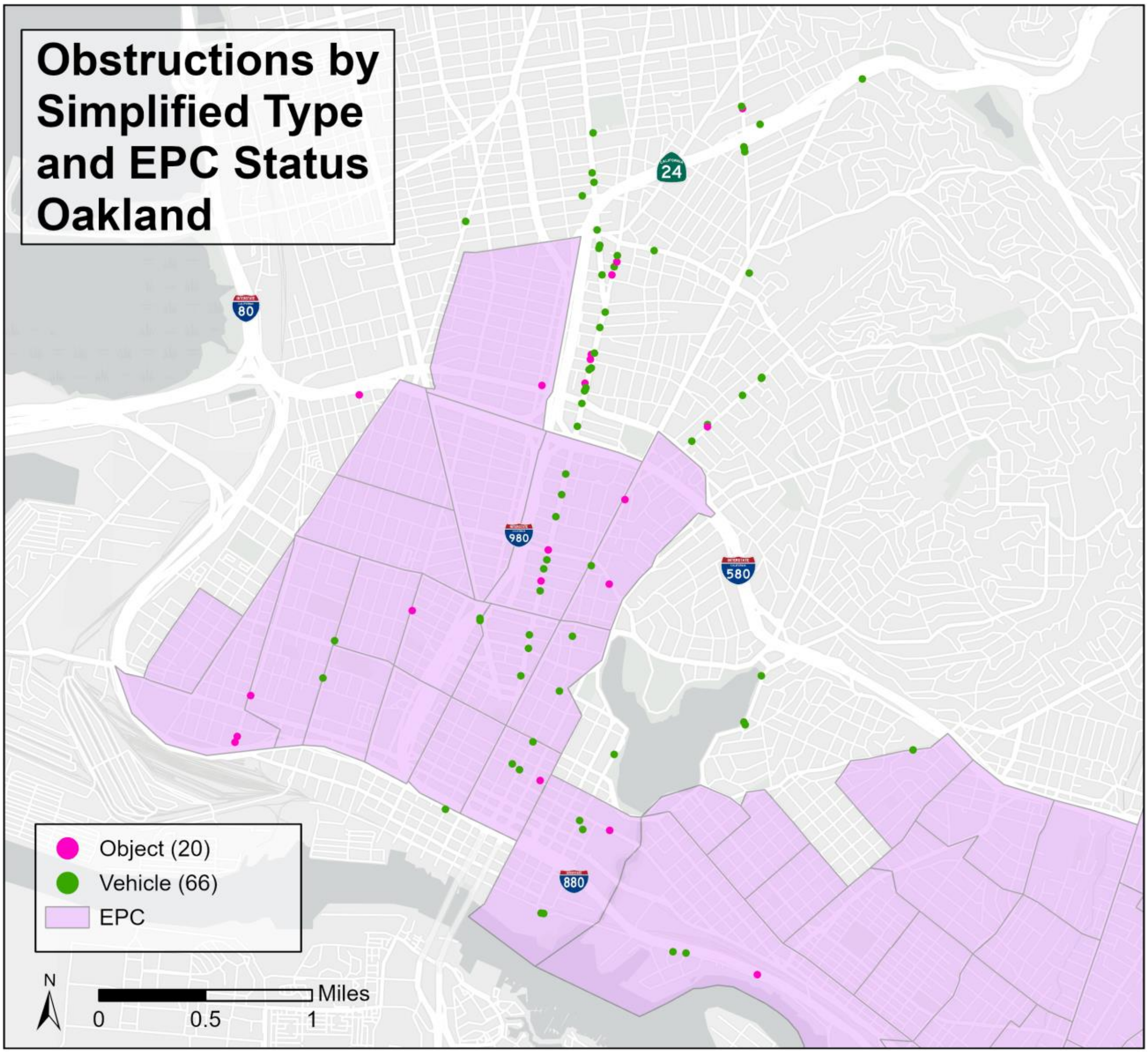
Data Sources: Esri, Metropolitan Transportation Commission, City of Oakland Open Data Portal

Figure 4.11: Map of Equity Priority Communities in relation to the San José City Limits



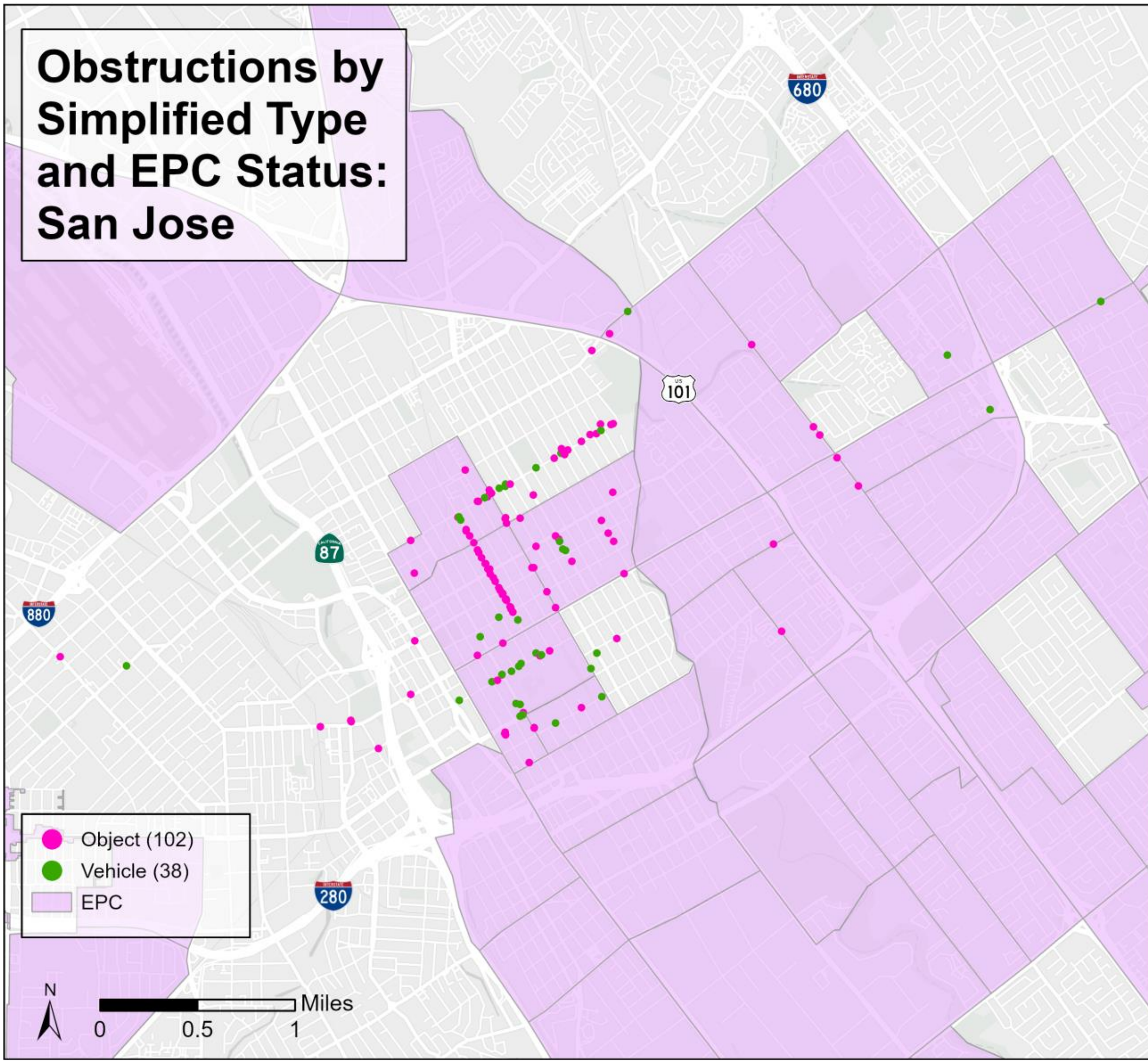
Data Sources: Esri, Metropolitan Transportation Commission, City of San José Open Data Portal

Figure 4.12: Map of Obstructions by Type within MTC Equity Priority Communities, Oakland



Data Sources: Author-Collected Obstruction Data, Esri, Metropolitan Transportation Commission, City of Oakland Open Data Portal

Figure 4.13: Map of Obstructions by Type within MTC Equity Priority Communities, San José



Data Sources: Author-Collected Obstruction Data, Esri, Metropolitan Transportation Commission, City of San José Open Data Portal

Chapter 4f: Limitations of this study

This study has made a concerted effort to understand the types of obstructions in the bike lane in two Bay Area cities as well as to understand factors that lead to their obstruction. Before moving on to policy recommendations that one or both study cities can follow to reduce the number of obstructions in their bikeway network, it is important to understand the limitations that affected the outcomes of this study.

First, this study was conducted for a Master's Planning Report at San José State University. The study was conducted by one individual. There was no funding provided for this study, so data collection had to take place in hours before or after class or work. With additional time or additional members of the research team, a much wider study area could have been covered at more regular intervals. A small number of obstructions in Oakland were submitted to the author via an Instagram account, mentioned in Chapter 3a. These obstructions (n=22) represent 25.5 percent of Oakland Obstructions and 9.7 percent of total recorded obstructions.

The author was only able to collect a limited number of obstructions. The analysis is based on the data collected by the author over a period of 16 months. While patterns were clear in the dataset, the sample size overall was small. It is uncertain if this sample is representative of the study cities. It is focused on core areas of each city's bikeway network. The methodology behind this study matches the analysis completed. It is, however, only a small amount of the analysis that could be completed with additional time, staffing, and funding. There are numerous bikeways within both study cities that were excluded given an inability to cover such a large area. It was decided that regular coverage of a smaller area would lead to a more robust dataset. Additionally, hours spent in the field conducting data collection were not guaranteed to generate significant numbers of obstructions.

The database could have been larger had outside datasets been combined with the dataset collected specifically for this project. The author reached out to a nationwide database of bike lane obstructions, *Bike Lane Uprising*, hoping to share data and use their collected obstruction records to strengthen the overall sample. Unfortunately, *Bike Lane Uprising* did not respond to multiple efforts to make contact. Their data was not publicly available, and their privacy policy explicitly prevents using a data scraping tool to extract their data points.[127] Their datasets in Oakland and San José are small by comparison to other cities where they have an established user base. Neither study city is large enough to be listed as a primary location on their obstruction map. While manual tabulation of their data points would have been possible, it did not feel appropriate in the spirit of their terms of service. This project did not want to risk running into any legal trouble simply to obtain more data points.

127. Bike Lane Uprising. "Website Terms of Use," Last updated September 14th, 2020. Accessed October 7th, 2023/ https://www.bikelaneuprising.com/terms-of-use

Chapter 5a: Overview of Findings from Interviews

In conjunction with the data collected through in-field data collection and limited crowdsourcing, interviews were conducted with planners at both study cities. The purpose of these interviews was to provide additional context both city-specific and general to use in creating a set of recommendations for cities looking to help deal with frequently obstructed bikeways. These recommendations are focused on concepts derived from the data analysis. However, by interviewing planners who have worked on bikeway projects at their respective cities, it is possible to create recommendations that are somewhat ground-truthed. Rather than create recommendations in a vacuum, the following set of recommendations has been colored by interviews with transportation planners at both study cities. The individuals who were interviewed for this study will remain anonymous, and heretofore will be referred to as planners from their respective cities. Each of these individuals has experience developing the bikeway network in the city they work in, and each planner was aware of bike lane obstructions in their city to some extent.

The level of importance placed on dealing with bikeway obstructions varied slightly between the study cities. Neither city had spent significant time or staff focus working on addressing bikeway obstructions as an area of concern. Neither city had established a specific initiative, and the lack of staff time was cited as a barrier towards beginning this work in earnest. Oakland planners noted that this was a multi-actor situation – many groups were involved within the city, and obstructions in the bike lane often fell outside of their purview. Determining responsibility for a particular stretch of roadway could be a challenge. Obstructions may involve outside organizations, such as waste collection companies.

Oakland staff mentioned the use of 3-1-1 as a method to report obstructions in the bike lane to the City. 3-1-1 is a special telephone number used to access non-emergency municipal services.[128] San José staff mentioned that it was a challenge to get any new features added to San José's 3-1-1 system, so currently the public cannot use 3-1-1 to specifically report a bike lane obstruction. San José planners noted that they do hear about bike lane obstructions from several concerned residents through a variety of channels – email, social media, and direct contact from bicycle activists. San José planners reported obstruction discussion at meetings of the city's Bicycle and Pedestrian Advisory Council (BPAC), a citizen committee that serves to advise City staff about the needs of bicyclists as well as those who walk and roll.[129] Both cities did cite a disconnect between planning stages, implementation stages, and maintenance stages of a bikeway project as potentially leading to obstructions.

128. Colin Wood, "What is 311?." *Government Technology*, August 2nd, 2016. https://www.govtech.com/dc/articles/what-is-311.html
129. City of San José, "Bicycle Pedestrian Advisory Committee," accessed October 7th, 2023, https://www.sanJoséca.gov/your-government/departments-offices/transportation/walking-biking/bicycle-pedestrian-advisory-committee

A feeling of "being silo-ed" or "disconnected" from other sections of each city's respective transportation department was mentioned by planners at both study cities. San José staff mentioned that the focus of their work as planners was to build more bike lanes to focus on reaching City mode shift goals. Dealing with maintenance is something that would be dealt with as needed.

Each city has spent time and funding on projects that would somewhat peripherally help with bike lane obstructions. Oakland cited purchasing a very small street sweeper to fit in Class IV, parking-protected bikeways as a step towards keeping them clear. While San José has spent more energy specifically on addressing bike lane obstructions than Oakland, both cities did cite a lack of staff hours and not prioritizing this specific issue as obstacles towards expanding any sort of program designed to reduce obstruction.

Oakland planners mentioned that keeping cars out of the bike lane is the highest priority, which seems like a prudent focus given the data collected for this project. Vehicle-related obstructions (n=66) accounted for over 75 percent of all obstructions found in Oakland. Oakland Planners noted that enforcement of parking in the bike lane is a challenge, as police patrols have declined heavily in the past several years. Trash in the bike lane in Oakland is typically categorized as "illegal dumping" and therefore falls outside of Oakland DOT's purview. Planners from Oakland did mention that Business Improvement Districts often employ street ambassadors who sweep the bike lane in the specific area that they are employed. Anecdotally speaking, this is true – street ambassadors were spotted in the bike lane during data collection on Telegraph Avenue. These ambassadors were generally conducting basic maintenance, such as removing broken glass.

San José staff were fully aware of the issues pertaining to unbundled yard waste and trash receptacles winding up in the bike lane. A planner interviewed for this project had previously dedicated a significant amount of their own work time to dealing with this issue in Downtown San José. However, this work was being done on an individual level, often with this planner working one-on-one with individual apartment building managers or residents to find better locations for specific dumpsters or trash cans. This specific planner is now working on a different team within the Department of Transportation and as such is no longer spending as much time working on this specific issue. The trash cans in bike lanes issue was not something that was specifically assigned to this planner as a task, but rather one that they came to work on somewhat organically.

While the most prevalent issues in both study cities vary, the interviews conducted for this report led to several key takeaways.

First, both cities are dealing with departments that are understaffed. Both cities have high vacancy rates within their Transportation departments, and obstructions in the bike lane seem to be an issue that is not being managed due to a lack of capacity.

Second, while both cities have taken steps to understand bike lane obstructions, it is not the primary work focus of any planner at either city – at the current moment or in the past. Third, residents in both cities have made city staff aware of bike lane obstructions, though the ways that staff and the public communicate are not standardized in either city. Finally, inter-department and intra-department coordination is an obstacle to successfully dealing with bike lane obstructions.

Chapter 5b: Recommendations for both study cities

What follows is a set of recommendations that both study cities can use to reduce the number of obstructions in their bikeway network. These recommendations are informed by the field-collected data on bikeway obstructions in both cities, as well as the interviews conducted with planners at both study cities.

Recommendation #1: Build more Class IV Protected Bike Lanes. Both cities saw a far lower number of obstructions in protected bike lanes as opposed to painted or buffered bike lanes (Class II). The number of Class II obstructions was over two times greater in Oakland (2.07) and San José (2.14) than obstructions in Class IV bikeways. Planner interviews concurred with the findings of this study – they do find that building protected bikeways works to reduce obstructions, however this is more of a side benefit. Creating safer bikeway networks is the primary goal of both study cities. That said, planners at both cities sited protected bike lanes as one of the best tools at their disposal to reduce obstructions, noting that protected bike lanes are the most visible, clear option to designate space exclusively for cyclists. The first chapter of this report effectively details the existing literature showing that actual and perceived safety of cyclists is higher in protected bike lanes. The findings of this report show that obstructions in these lanes are less common. This only adds to the actual safety of riding in a protected lane.

Recommendation #2: Consider more efficiently usage of small, narrow sweepers to sweep protected bike lanes. Larger sweepers struggle to effectively sweep protected bike and pedestrian infrastructure. Sweeping the bike lane is necessary to reduce obstructions, but also essential from a stormwater maintenance perspective. Sweeping the lane of debris and pollutants helps keep them out of our creeks, rivers, and bay.

San José infrastructure maintenance staff noted that some protected bike lanes require the sweeper to back in, which adds to the time it takes to sweep a street. Additionally, street sweeping can take twice as long if a sweeper must make two passes. Larger sweepers need seven to eight feet of clearance to turn around. Mini sweepers could help with this issue. San José has used a narrow sweeper for protected bike lanes for three years, yet still runs into challenges with implementation.

Oakland staff were proud of their small, mini-sweeper which fits in their new Telegraph Avenue bikeway. San José planning staff noted the hesitance of their infrastructure maintenance division to use such small sweepers, despite their existence. These smaller sweepers apparently fill up with debris faster and need to be emptied more frequently. Additionally, these sweepers cannot drive as fast and therefore are not able to go longer distances to dump their collected waste. To effectively use mini sweepers in bike lanes, cities should look to create larger dumping points in strategic areas along bike lanes so smaller sweepers can be more effective.

Recommendation #3: Consider more permeable barriers when building protected bike lanes but scale these barriers for objects smaller than a car. When an obstruction occurs in a Class IV bikeway, often it is impassable for a cyclist, as the obstruction occupies the entire lane. With quick-build barriers such as flexposts, it is easy for a cyclist to temporarily merge into vehicle traffic to clear an obstruction. When upgrading this infrastructure to hardscaped protection, such as a curb, consider leaving permeable gaps in that protection large enough for a bike to exit.

This way, cyclists are not trapped in protected bike lanes and forced to ride on the sidewalk. While San José municipal code does allow anyone to ride a bicycle on the sidewalk if the bike lane is obstructed[130], asking people to ride on the sidewalk in case of an obstruction is likely to cause more frequent interactions with pedestrians.

San José staff mentioned that the ongoing revisions of the NACTO *Urban Bikeway Design Guide* include a section on permeability standards for protected bike lanes. Once this guidance becomes available, planning and design staff at cities should incorporate permeability into their barriers, both for cyclists and ideally for mini-sweepers. San José infrastructure maintenance staff noted that a bike lane obstruction (especially a parked car in a Class IV bikeway) could force their current sweeper to reverse the entire length of a block if they could not exit the bike lane. Obstructions in bike lanes can lead to sweeping being skipped. This can create somewhat of a negative cyclical effect wherein obstructions are not cleared because of obstructions. Some mini-sweepers, such as the Madvac LS175 used by the City of Houston, Texas[131] are only 48" wide.[132] This self-perpetuating cycle could potentially be remedied by a more permeable barrier, provided that the barrier was permeable enough for a cyclist or mini-sweeper to exit but tight enough to prevent cars from entering the bike lane. The average width of a car is 5.8 feet.[133]

130. *City of San José Municipal Code,* Chapter 11.72.200, D. Accessed October 7th, 2023, https://library.municode.com/ca/san_José/codes/code_of_ordinances?nodeId=TIT11VETR_CH11.72BI_11.72.190BIRIPRSIANDEAR
131. Adam Zuvanich, "Houston will let you name the city's new mini-street sweeper", *Houston Public Media*, August 22, 2022. https://www.houstonpublicmedia.org/articles/news/houston/2022/08/22/431374/naming-contest-for-small-street-sweeper-getting-big-response-from-houstonians/
132. "Mini Sweeper LS175," Madvac. Accessed October 7th, 2023, https://madvac.com/models/mini-outdoor-street-sweeper-ls175/
133. Susan Meyer, "Study: Average Car Size is increasing – will roads still be safe for small cars and pedestrians?", *The Zebra*, August 31st, 2023. https://www.thezebra.com/resources/driving/average-car-size/

Recommendation #4: Consider adding a bollard at entrance points to Class IV bikeways. While this is a trickier recommendation, it could be very effective in keeping cars out of the bike lane. Class I bike paths do this regularly, though they are fully off-street, and frequently seen in regional parks. These bollards are often removable and locked in place with a combination lock to allow maintenance vehicles to enter the bike lane but prevent private vehicles from driving on the path.

If cities are interested in following this recommendation, they should target the placement of these bollards strategically, and consider using flexposts or spring-return bollards to permit emergency vehicles to enter, if necessary, without stopping to remove a lock. San José planning staff noted that street sweeping staff would likely be very apprehensive to this concept, as it would greatly increase the amount of time it took to sweep bikeway infrastructure by requiring staff to remove and replace a post at the end of every block of protected bikeway. Interviews pointed to existing safety requirements that prevent drivers from exiting the sweeper, so additional staff or a change in requirements would be necessary.

Recommendation #5: Build space for dumpsters into bikeway plans and use street infrastructure tools to create space for dumpsters and garbage cans on the street near existing bikeways. Interviews with planners from both cities pointed out that staff is aware of specific places in each of their respective cities where dumpster/bike lane interactions are a known issue. Both cities mentioned that they need to deal with these design issues early in the development phase – of a bikeway as well as of a building. Oakland and San José staff spoke to the development review period as crucial for identifying potential protected bike lane blockages and working with developers and waste management providers to identify a solution before implementation. Oakland staff mentioned working with developers to move dumpster pickup onto adjacent side streets, if possible, or add dumpster cutouts into bikeway separation islands.

Figure 5.1: Example of bollard-protected Class I bike path, Lafayette-Moraga Regional Trail.

San José staff also mentioned designing specific bikeway locations around garbage cutouts. San José staff emphasized the importance of looking at this sort of issue early in the development process, as it can be harder to make behavioral changes once things begin to unfold a certain way. San José planners noted that the discussion of a potential obstruction is something that does come up when considering a specific bike lane treatment, though this is usually regarding parked cars and not necessarily inanimate objects such as dumpsters.

San José staff noted success with using armadillo delineators to create space for dumpsters and prevent them from rolling into the bike lane. Creating space for dumpsters in the right of way can be a challenge, especially with the multiple demands for a limited amount of space in urban areas. There are safety implications, however, when dumpsters are allowed to obstruct the bike lane.

Recommendation #6: Create more flexible curb space in commercial areas with high frequency of deliveries. Mode shift goals push cities to reduce available space in the public right-of-way for cars to provide space for pedestrians, transit, and bicyclists. At the same time, people are ordering more things online now than ever before – and this was accelerated by the COVID-19 pandemic.[134] With more online orders comes more deliveries, and more delivery vehicles. While companies like Amazon are using electric cargo bikes to make deliveries in places like the United Kingdom[135], this is not currently a common practice in the United States. There is a growing need for more space at the curb for vehicles to park for short periods of time.

134. United Nations Conference on Trade and Development, "Covid-19 has changed online shopping forever, survey shows." October 8th, 2020. https://unctad.org/news/covid-19-has-changed-online-shopping-forever-survey-shows
135. Andrew J. Hawkins, "Amazon is using electric cargo bikes that look like mini-trucks to make deliveries in the UK," *The Verge*, July 4th, 2022, https://www.theverge.com/2022/7/4/23194412/amazon-ebike-walking-delivery-london-hub

Figure 5.2: An armadillo (left) may have been useful in preventing the dumpster (right) from obstructing the bike lane.

Cities should consider striping portions of the curb as loading zones or implementing very short parking zones in areas with lots of demand for deliveries. Creating a space for delivery trucks to park outside of the bike lane is essential as the number of delivery vehicles on our streets increases. Until companies are forced through policy to use a different delivery model, trucks are going to be delivering packages across America. Cities can think proactively to provide more space and help alleviate the issue of these trucks parking in the bike lane. Proper curb management and curb demand strategies are outside of the scope of this report, but integrating curb management and bikeway network planning is a technique that can hopefully lead to co-benefits for both sides – a more useful bikeway network and more readily available curb space.

Recommendation #7: Educate the public on how protected bike lanes are supposed to work. For a lot of people, protected bike lanes are new in terms of the type of things they're used to seeing on the streets. Over the past few years, both Oakland and San José have added Class IV bikeways on prominent streets. Oakland's Telegraph Avenue bikeway was originally built with quick-build techniques and is now being upgraded to hardscaped elements. When the bike lane first went in, there were frequently cars parked in both the parking spaces (which were meant to separate bicycle traffic from moving cars) as well as in the bike lane.

Cities should use signage during and after bikeway construction to show people where the parking spots are and where the bike lane is. It seems simple, but parking-protected Class IV bikeways are essentially the reverse layout of the Class II bike lanes that many people are used to. This is especially confusing for drivers when the bike lane is repositioned to run next to the sidewalk, but the individual parking meters corresponding to parking spaces are still located at the sidewalk. When bike lanes are only protected with flexposts, it is not a challenge to see how cars end up parking in the bike lane, especially when it is new. Using targeted signage – either attached to the flexposts, the hardscaped bike lane separator, or on the sidewalk can help drivers understand how the street design is supposed to work. These signs are used in the study cities, but not universally with new bikeway construction.

Figure 5.3: Educational signage in use on San Fernando Street in San José. Source: City of San José

Interviews with San José planners pointed to a need for education in between the planning and implementation process, as well as after implementation. When bike lane designs become more unique or site-specific, people are more likely to be confused. City staff noted that they would like to assume that not all bike lane obstructions caused by parked cars are on purpose and suggested that an 'education-before-citation' system would be useful to reduce potential negative feedback on more unconventional bikeway designs.

Recommendation #8: Be creative. Design bikeways with site-specific information in mind and develop bikeway plans that allow for flexibility. Creating plans that allow for flexibility on bikeway class and bikeway design will allow cities to create more usable bikeways for a specific location.

Oakland staff mentioned the bike lane in front of the Moxy Hotel on Telegraph – in this case, the bike lane is routed onto the sidewalk allowing for vehicle drop-off and pick-up at the curb. Pedestrians must interact with the bike lane, but it completely skirts the travel lane for this specific segment. Using this type of design at places where there are a lot of pick-ups and drop-offs (transit stations, schools, valet zones) is just one idea. San José often has wider curb-to-curb widths to work with than Oakland. An example of creative bikeway design in San José is the 10th/11th street through lane/frontage lane design. San José took these two streets, both one-way streets, and re-organized the lane design so that two lanes remained normal through lanes, and the right lane became a curb-separated frontage lane. This lane is only for bikes and for drivers who are trying to park on that specific block or enter their own driveway. The bike lane becomes fully protected at the intersection, and drivers must make a slow right turn around a protected island. The frontage lane is effectively a large, mostly-protected bike lane, with room for cars to pass cyclists.

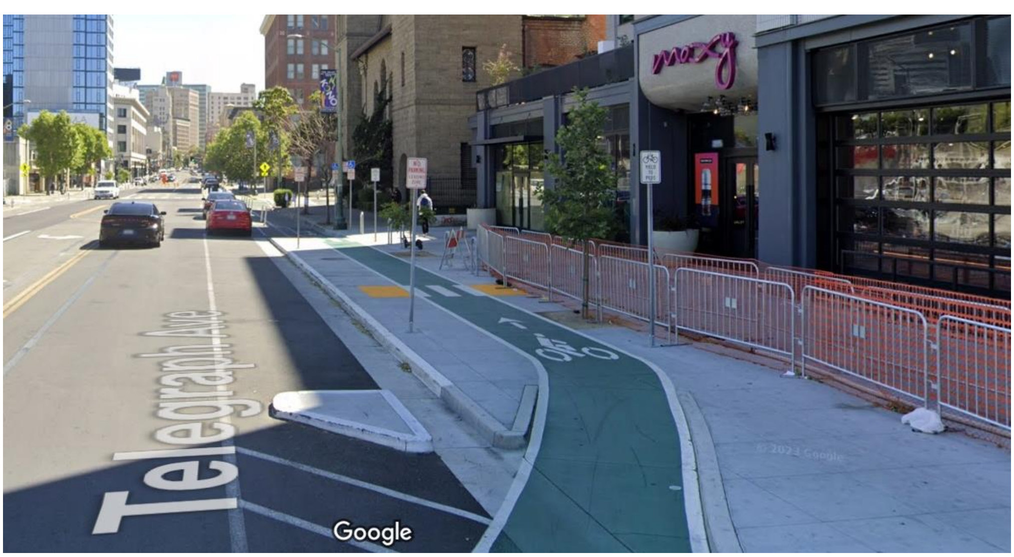


Figure 5.4: Sidewalk bike lane by Moxy Hotel, Oakland. Source: Google Street View

Anecdotally, speeds are noticeably slower in this lane than the two through lanes. This project is site-specific – using coupled one-way streets to re-allocate space and make a safer place for cyclists – worked perfectly on these streets in San José. It is now being adapted to suit another coupled one-way street segment in San José – 2nd and 3rd street, south of I-280, according to interviews with San José planners. This method is less frequently obstructed due to its width. Oakland has plenty of one-way streets west of Downtown which this could be considered for.

There is not one catch-all solution here, and that's the point. Cities should use what works for them and lean into creative methods of making more effective bikeways, even if additional education or engagement is required.

Chapter 5c: Oakland-Specific Recommendations

Recommendation #1: Reconsider using parklets next to protected bike lanes or add very specific guidance and only permit parklets next to protected bike lanes in specific situations. This recommendation does not come specifically from the data collection, but from the data collection process. There are numerous parklets on Telegraph Avenue, and since the Class IV bikeway runs next to the curb, the bike lane is often separated from traffic by the parklet as opposed to parked cars. Parklets can be taller than parked cars and frequently have roofs to keep diners sheltered while eating and drinking. Parklets to the left of a bike lane leads to very poor visibility for cyclists, especially near intersections. The parklet prevents drivers – especially those turning right – from seeing cyclists who are riding in the same direction.

Additionally, upgrading permitting for parklets is necessary, even when the parklet abuts a Class II bike lane. Two specific parklets on College Avenue in Oakland were wider than the space between the curb and the right edge the bike lane stripe. These parklets were permanently reducing the width of the bike lane on this stretch of College Avenue. Parklets did not obviously lead to more obstructions of Class IV bikeways, but they do induce significantly more pedestrian travel across the bike lane. Restaurant and bar staff often must wait tables while crossing an active bike lane to reach their seated patrons.

Figure 5.5, at right: Parklet and bike lane interaction on College Avenue in Rockridge, Oakland. The parklet is wider than its allotted space and is permanently obstructing the bike lane.

Chapter 5d: San José-Specific Recommendations

Recommendation #1: Consider requiring yard waste to be bundled or set out in closed receptacles. End the free unbundled yard waste option for residents. Unbundled Yard Waste was the third most common type of bike lane obstruction recorded for this project. It was also a phenomenon unique to San José. At the time of writing, San José is the 11th or 12th largest city in America (it is within 100 people of Jacksonville, Florida – plus these are estimated numbers. City of San José Public Information Staff is currently using 11th when referring to San José's ranking). All 11 cities larger than San José require that curbside yard waste is either placed in bins, bags, or bundles. See Table 18 on the following page for details. While it varies, many of these cities also mandate that residents pay for either specific bins or city-approved bags in which this waste must go if they want it to be picked up curbside. Unbundled yard waste is the kind of policy that would make sense in a rural area. Unfortunately, a large majority of San José is hardly rural.

While the City of San José has specific set-out requirements for unbundled yard waste, including pile size limits and rules for set-out placement and timing, the reality of the situation is that these rules are not regularly followed. Yard waste may start in the correct place, but unbundled piles are prone to moving, especially on windy days. Additionally, after the pile is picked up, there inevitably is some residual waste left on the street. Residents are supposed to return to the pile and sweep it up, but again, this does not regularly happen. If this waste is in a bike lane – especially a protected one – it may not be collected by the City street sweepers, as conversations with infrastructure maintenance staff made clear. This can lead to additional debris making its way into storm drains and into San José's creeks and rivers.

San José currently offers green bins for yard waste and compost to residents at an additional charge of $6.85 a month, or $82.20 a year. At a minimum, the City should look to eliminate the ability to allow residents to place their yard waste loose in the street. No other city of close to 1,000,000 residents in the United States permits this kind of on-street placement of refuse. Staff noted that requiring green bins would require an amendment to the municipal code.

San José's bicycle planning staff are keenly aware of this issue. They receive numerous resident complaints about obstructed bike lanes due to piles of yard waste. Staff could recite specific locations where this was a regular issue. Staff was united in the belief that the garbage hauler contracts were incredibly hard to modify, and each contract lasts for 15 years. The city contracts with multiple garbage haulers depending on the sort of waste (trash, recycling, green waste) and the type of building (residential, commercial). Coordinating actions between multiple actors was cited as a challenge, especially when the negotiation of contracts between the City and the haulers is already a hot button issue.

Table 5.1: Green Waste Setout Guidelines for the 12 Largest Cities in the United States

City	Population (US Census: July 1, 2022 Estimate)	Green Waste Policies
New York, NY	8,335,897	Must be in a labeled bin with a secure lid or an official city bin. Extra waste can be bagged separate from trash.[1]
Los Angeles, CA	3,822,238	Green bins are provided for yard waste, grass clippings, leaves, branches, etc. Brush must be tied together and bundled for collection.[2]
Chicago, IL	2,665,039	Yard waste must be bagged separately from garbage or recycling.[3]
Houston, TX	2,302,878	Yard waste must be placed in a City Approved compostable bag for collection.[4]
Phoenix, AZ	1,644,409	Phoenix provides a tan container for = yard waste, such as grass clippings, twigs, branches and shrubs. The additional monthly fee for the Green Organics Collection program will be $5 a month per tan container requested.[5]
Philadelphia, PA	1,567,258	The city of Philadelphia collects fallen leaves for composting as well as for trash, but they must be bagged either way.[6]
San Antonio, TX	1,472,909	San Antonio offers leaf collection of bagged leaves only. Leaves must be bagged in paper or in cardboard boxes.[7]
San Diego, CA	1,381,162	Must use city provided container. Large format yard waste such as trees must be handled by a private hauler.[8]
Dallas, TX	1,299,544	Allows monthly unbundled yard waste pickups but requires residents to place the pile on their property curb line as opposed to the street or sidewalk.[9]
Austin, TX	974,447	Provides green carts, extra bags or bins may be used, any branches must be bundled. Larger loads must be taken to a facility.[10]
Jacksonville, FL	971,319	Waste must be bagged and there are limits on limb and log size.[11]
San José, CA	971,233	San José offers two ways to collect yard trimmings: Place your yard trimmings loose in the street (no extra charge) or place in your optional yard trimmings cart for collection.[12]

Table 5.1-Specific Reference List

1. https://www.nyc.gov/assets/dsny/site/services/food-scraps-and-yard-waste-page/leaf-and-yard-waste
2. https://www.lacitysan.org/san/faces/home/portal/s-lsh-wwd/s-lsh-wwd-s/s-lsh-wwd-s-r/s-lsh-wwd-s-r-rygb
3. https://www.chicago.gov/city/en/depts/streets/provdrs/streets_san/svcs/yard_waste.html
4. https://www.houstontx.gov/solidwaste/services.html
5. https://www.phoenix.gov/publicworks/recycling/green-organics-and-say-r-r
6. https://www.phila.gov/services/trash-recycling-city-upkeep/recycle-fall-leaves/
7. https://www.sa.gov/Directory/Departments/SWMD/Special/Bagged-Leaf
8. https://www.sandiego.gov/sites/default/files/legacy/environmental-services/pdf/collection/greenery.pdf
9. https://dallascityhall.com/departments/sanitation/pages/brush_and_bulky.aspx
10. https://www.austintexas.gov/composting
11. https://www.coj.net/departments/public-works/solid-waste/yard-waste-(1)/yard-waste
12. https://www.sanJoséca.gov/your-government/departments-offices/environmental-services/recycling-garbage/residents/yard-trimmings-street-sweeping

For context, a previous mayor of San José, Ron Gonzales, was once arrested on suspicion of accepting a bribe related to a garbage contract.[136] The timeliness of this issue prevented an interview with anyone from the City of San José Environmental Services Division (ESD). The Integrated Waste Management division of ESD was just audited in September 2023 – specifically their enforcement division.[137]

The audit had three major findings and made seven recommendations. The findings include clarifying the mission and workload expectations of the Integrated Waste Enforcement (IWM) team, working more proactively citywide as opposed to reactively dealing with existing complaints, and streamlining administrative tasks to give inspectors more time in the field.[138] The second finding specifically related to this study. The single recommendation based on this finding was that the IWM team should "update proactive case procedures to target areas where there is a risk of underreported issues, *particularly in areas with high concentrations of multi-family and commercial properties."*

This report effectively highlights the City's awareness that underreporting of violations is an issue, and especially so in areas with a high density of multi-family and commercial properties. This finding from the IWM audit matches this study, which found a higher concentration of bike lane obstructions from waste bins and unbundled yard waste in higher-density residential areas. What this report omits is the impact that these sort of obstructions can have on cyclists in San José.

136. Henry K. Lee, "San José Mayor, aide, arrested in garbage scheme," *SFGate*, June 23, 2006, https://www.sfgate.com/bayarea/article/san-José-mayor-aide-arrested-in-garbage-scheme-2494255.php

137. City of San José City Council Meeting Amended Agenda, September 26, 2023, Section 3.4, Item 23-1279, *Integrated Waste Management Enforcement Program Audit Report.* Accessed October 7th, 2023, https://sanJosé.legistar.com/View.ashx?M=A&ID=1118763&GUID=29165DBC-653C-4E8E-84CF-54B00F1B473D

138. City of San José Office of the City Auditor, Report to the City Council, "Integrated Waste Management Enforcement Program: Clarifying Goals and Performance Expectations Would Improve Enforcement Coverage," Report 23-03, September 2023, Accessed October 7th, 2023, https://sanJosé.legistar.com/View.ashx?M=F&ID=12287073&GUID=BCEC46C1-4F70-4001-A3C9-07553929CD48

Figure 5.6: City of San José Yard Trimmings Setout Guidelines. Source: City of San José

Fortunately, the City Council Agenda from September 26th, 2023, includes letters from the public regarding the audit of the IWM program. The packet of public comment is 70 pages long, filled with 53 photos of trash cans, dumpsters, and unbundled yard waste obstructing the bike lane, submitted by San José residents. In the written section of the public comment, one resident sums up his issue with the audit quite succinctly: "there are huge gaps in the analysis, given that the report does not once mention bike lanes, nor does it show pictures of trash in bike lanes...nor does it mention people who have been directly injured or killed by illegal trash set-outs in bike lanes."[139]

The most recent incident – which this comment is referring to – occurred on May 15th of this year. A 37-year-old man was riding a scooter in the bike lane on Lundy Avenue near Rosebriar way when he "struck a brush pile in the bike lane and was ejected from the scooter"[140] - he died from his injuries two days later in the hospital. The public comment on the IWM audit notes that "illegal dumping is for sure a health hazard that should be tackled, but the endemic of illegal set-outs is directly placing the lives of every cyclist at risk on a daily basis."[141]

While the comment may be slightly hyperbolic, the sentiment is not – obstructions in the bike lane, especially in low light conditions, pose a serious hazard to cyclists and scooter riders, especially those traveling at high speeds. Reforming the unbundled waste policy may be a challenging task given the entrenchment of language in several garbage contracts, but it is not exaggerating to say that lives are at risk. Simply switching to bundled yard waste would not have prevented this accident. It is necessary for the City to combine the recommendations cited in the IWM audit with the understanding that obstructions in the bike lane are a serious issue. This needs to be enforced by inspectors as well as reduced by individual haulers in during the collection process and individual residents during the set-out process.

Thankfully, this recommendation and this report in general are quite timely. Per the minutes from the September 26th meeting, City Council approved the IWM audit unanimously but gave explicit direction to city staff to "return to the Transportation and Environment Committee with enforcement options to keep bike lanes clear from any obstructions"[142] with this work being led by the IWM team. Given the level of public comment related to this issue, there appears to be a somewhat informal citizen's watchdog committee taking shape here. Hopefully, the public will hold the City Council and IWM team to their word.

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139. City of San José City Council Meeting Amended Agenda, September 26th, 2023, Section 3.4, Attachments, "Letters from the Public", Accessed October 7th, 2023, https://sanJosé.legistar.com/gateway.aspx?M=F&ID=e03d1f4c-f4ca-437d-95e8-a65a0875f413.pdf
140. Austin Turner, "Scooter driver who was ejected after hitting brush pile dies in hospital," *San José Mercury News*, May 24th, 2023, Accessed October 7th, 2023, https://www.mercurynews.com/2023/05/24/san-José-scooterist-ejected-after-hitting-brush-piles-dies-in-hospital/
141. Letters from the Public, ibid.
142. City of San José City Council Meeting Minutes Draft, September 26th, 2023, Section 3.4, Item 23-1279, "Action". Accessed October 7th, 2023, https://sanJosé.legistar.com/View.ashx?M=M&ID=1118763&GUID=29165DBC-653C-4E8E-84CF-54B00F1B473D

Recommendation #2: Consider revising garbage set-out rules to allow for more flexibility as to where cans are initially placed by residents. Additionally, look to increase on-site pickup in areas with higher density housing. Currently, San José's setout guidelines require residents to place their cans (referred to as carts in city documentation) side-by-side in the street, two feet apart and with wheels against the curb.[143] Carts also must be five feet away from anything that may block the collection truck, including parked cars. While instructions on the city website say to keep carts out of bike lanes, the findings of this project show that this does not necessarily happen. Given that garbage cans were found in the bike lane on the day after trash collection, as well as late in the afternoon or early evening on the day of collection, cans are being placed in the bike lane both before and after pickup has occurred. Reforming the setout guidelines as well as the hauler contracts to allow for set-out on the driveway apron or planting strip on streets with a bike lane could significantly reduce obstructions. Interviews with San José planners indicates that in certain situations, such as on narrower streets, this is already the case. A specific block of Bird Avenue in San José was viewed using Google Street View; it has one lane of car traffic in each direction and parking only on one side of the street. On the side of the street where cars cannot park, garbage and recycling carts were spotted on the planting strip – the section of the sidewalk between the curb and the through zone, where people walk. Given that in specific situations setout occurs on the planting strip, the City should look to incorporate alternative setout locations on streets with residential zoning and a bike lane.

143. City of San José, "Residential Homes Collection & Setouts", n.d., accessed October 7th, 2023, https://www.sanJoséca.gov/your-government/departments-offices/environmental-services/recycling-garbage/residents/residential-homes-collection-setouts

Figure 5.7: City of San José Curbside Setout Guidelines. Source: City of San José

Additionally, on-site pickup, where the garbage hauler retrieves the cans from their location on a specific property, collects the garbage, and returns the can to its original off-street location is something that the city does offer, but for an additional fee. While this sort of collection is more time-consuming for the garbage hauler, it also could significantly reduce the multiple can obstructions seen regularly in higher density housing zoning during the data collection for this report. This sort of on-site pickup should be a more feasible option on streets with bike lanes and higher-density residential zoning.

This report also recommends targeted education to residents and landlords in areas with a higher concentration of trash and recycling cans. Each of these cans has a serial number, and the location of each can in the city should be known by ESD or the individual hauler, depending on who owns the can. Using this data, the City should conduct outreach in areas where a higher concentration of cans exists and ensure that people are made aware about not setting cans out in the bike lane.

Interviews with planners clearly highlighted that these garbage contracts are very hard to modify. Planning staff can recommend changes but lack the regulatory teeth to make those happen without support of policymakers. Hopefully, the current situation with City Council and the Integrated Waste Management division audit can be used to push the needle on making these kind of changes to the garbage contracts. This change would greatly reduce bike lane obstructions, increase overall cyclist safety, and hopefully contribute to the increased mode share tied to the City's climate goals.

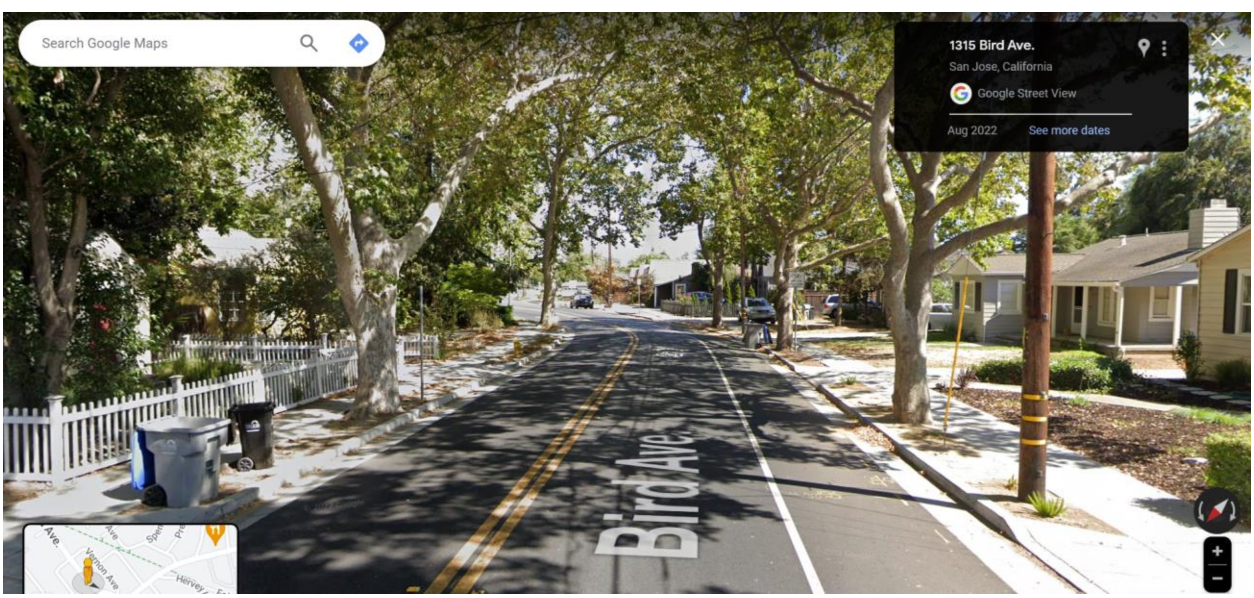

Figure 5.8: Bird Avenue in San José, cans visibly set out on the planting strip. Source: Google Street View

Recommendation #3: Consider using lock-to requirements for shared micromobility devices (scooters) in targeted areas of San José. During the data collection period for this project, 14 obstructions related to scooters were recorded in San José. In Oakland, no scooters were found obstructing the bike lane during data collection. Oakland requires users of shared scooters to end their trip by locking the scooter to a bike rack, in-street corral, or City street sign to "ensure that scooters (are) not left obstructing sidewalks, curb ramps, or bus stops."[144] Lock-to requirements are used in other cities, such as Washington D.C. The main drawback of lock-to requirements is that they reduce available bike rack space for cyclists looking for a place to park. Additionally, lock-to requirements require adequate compliance and enforcement resources to be effective. End-trip photos must be reviewed to ensure that requirements are being met.

It is the recommendation of this report that lock-to requirements only be applied in Downtown San José, where bike racks are far more plentiful than in more residential neighborhoods outside of downtown.[145] Enforcing a lock-to requirement in a suburban San José neighborhood could force scooter users to lock devices to private property to end their trip in the respective operator's app. Limiting the lock-to requirement to a specific area is possible, as each scooter is tracked using GPS by the operator, and the operator's app is always aware of the location of a rented scooter, as long as it has not been intentionally damaged. The City could work with operators to set a specific lock-to zone and use targeted education campaigns to ensure that users know where and how to lock their devices within Downtown.

Oakland stipulates no more than one scooter per bike rack to ensure adequate parking space for both scooters and bikes. This is a challenging rule to enforce, so proper fleet rebalancing of shared scooters would be essential to making this work. Additionally, Oakland uses permit fees collected from each operator to help fund the installation of new bike racks in the city. The permit fees paid for 21 new bike racks in Oakland, eight of which have already been installed.[146] Both Oakland[147] and San José[148] currently allow members of the public to request bike racks in specific locations.

This recommendation is much more feasible from a regulatory perspective than the previous two. Establishing a lock-to requirement does not require amending a 15-year long contract, as is the case with the garbage haulers.

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144. "City of Oakland Announces 2021 E-Scooter Service Providers, Safety Improvements to Overall Program." City of Oakland, October 30th, 2020, https://www.oaklandca.gov/news/2020/city-of-oakland-announces-2021-e-scooter-service-providers-safety-improvements-to-overall-program
145. City of San José Open GIS Data Portal. "Bike Racks," accessed October 7th, 2023, https://gisdata-csj.opendata.arcgis.com/datasets/CSJ::bike-racks/about
146. "E-scooter Program Update," Oakland Bicycle and Pedestrian Advisory Committee Blog, May 2021, accessed October 7th, 2023, https://oaklandbpac.org/2021/05/25/escooter-update/
147. City of Oakland. "Request a Bike Rack," accessed October 7th, 2023, https://www.oaklandca.gov/services/request-a-bike-rack
148. City of San José. "Bike Parking," accessed October 7th, 2023, https://www.sanJoséca.gov/your-government/departments-offices/transportation/walking-biking/bike-parking

However, there are legitimate operational challenges with trying to enforce a lock-to requirement, especially regarding proper fleet rebalancing. Successful implementation of this recommendation would require a true partnership between the City, the operators, and scooter riders to ensure that scooters did not overburden bike rack capacity or wind up locked to private property. The lock-to requirements are effective. In Oakland, after the requirement was initiated, improperly parked scooter reports in OAK311 decreased by 15 percent.[149] This may seem small, but 100 percent of the violations which stemmed from these reports were resolved within three hours, and no fines were issued after the lock-to requirements were initiated.[150] Prior to the requirement, there were an average of eight fines issued per month.[151]

149. E-Scooter Program Update, 2021.
150. E-Scooter Program Update, 2021.
151. E-Scooter Program Update, 2021.

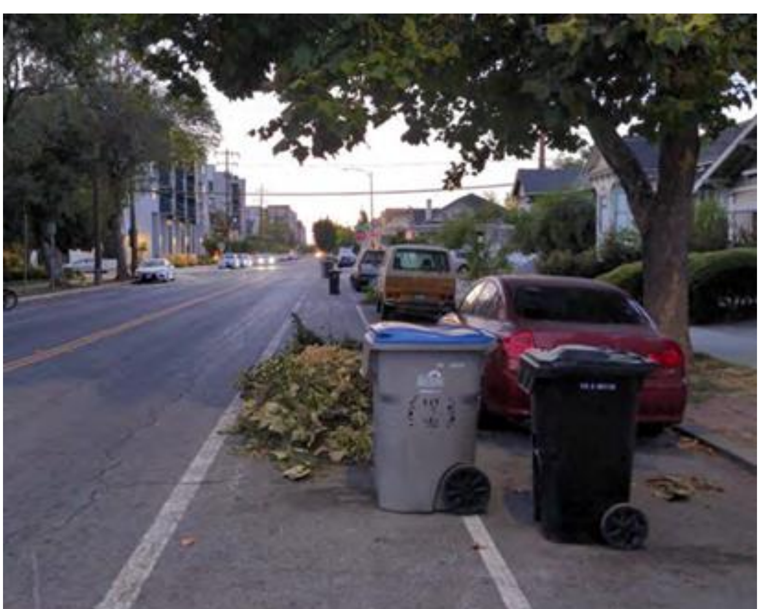

Figure 5.9: Unbundled Yard Waste and Recycling Bins obstructing a Class II bike lane in San José.

Photo Source: [Jordan Moldow](#).

Figure 5.10: Two shared scooters blocking the bike lane on San Fernando Street in San José.

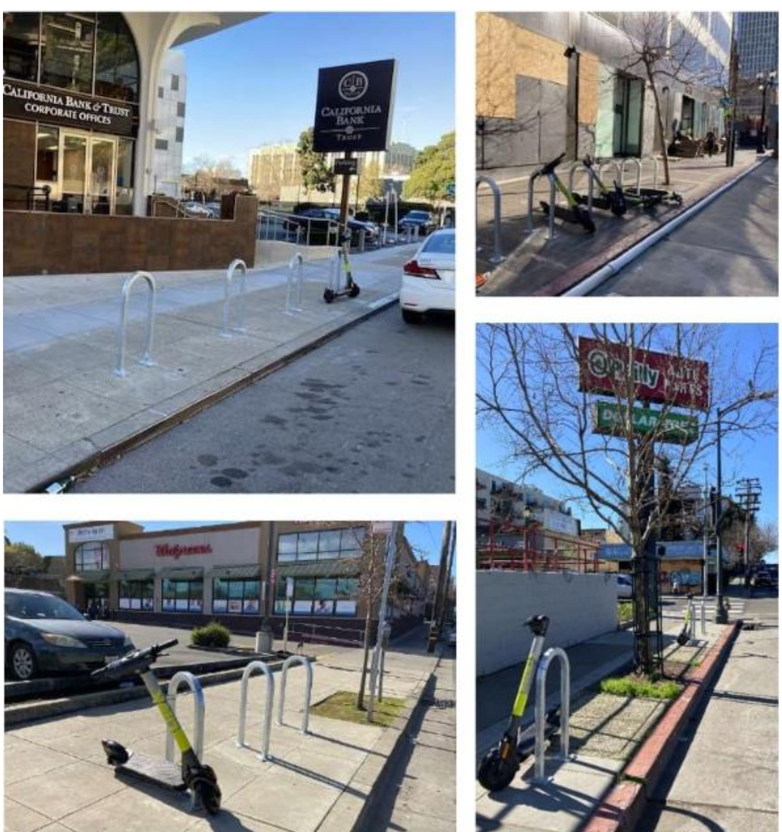

Figure 5.11: Scooters locked to bike racks in Oakland. These specific bike racks were funded by scooter permit fees paid for by the operators.

Source: [City of Oakland BPAC.]

Chapter 6a: Review of Findings

This project combined quantitative analysis of field collected obstruction data with qualitative interviews conducted with planners at both study cities. This report set out to determine what are the factors that lead to obstruction of the bike lane. In analyzing the 226 recorded obstructions, several key findings were uncovered.

- First, twice as many obstructions were recorded in Class II bike lanes as compared to Class IV. This held true across both study cities, despite recording more obstructions in San José than Oakland. Additionally, this held true despite a variance in constructed Class IV bikeway mileage in the two study cities.

- Obstructions comprised of more than one object (multiple obstructions) were far more common in San José as compared to Oakland. These multiple obstructions were frequently related to garbage or recycling can obstructions, as well as due to unbundled yard waste.

- The most common obstruction by type varied across both study cities, as well as by bike lane class. In Oakland, obstructions due to parked or idling vehicles (police vehicles, delivery vehicles, work vehicles, and private vehicles) accounted for over three-quarters of all obstructions. This pattern remained consistent across both types of bike lane – though parked vehicles were seen in Oakland's Class II bike lanes at much higher rates than Class IV bikeways (almost three to one). In San José, the most common obstructor of the bike lane was the garbage or recycling bin. These obstructions were the most likely type to result in multiple obstructions, and these were very prevalent north of Downtown San José in the residential neighborhoods between 7th and 21st Streets. Garbage bin obstructions were often seen in conjunction with unbundled yard waste obstructions, which were a unique obstruction type to San José. Both obstruction types were more common in Class II bike lanes than Class IV bikeways.

- Obstructions in Class IV bikeways, while less frequent, were more likely to result in an impassable obstruction that would force a rider to dismount their bike and potentially walk on the sidewalk to pass the obstruction. Of the 72 obstructions recorded in Class IV bikeways across both study cities, 53 percent were deemed impassable based on a metric created for this study. By city, this number was much higher in Oakland. 75 percent of Class IV obstructions in Oakland were deemed impassable.

- Obstructions in Oakland were far more common in commercial zoning districts (n=56) than any other type of base zoning. The CN zoning type (Commercial Neighborhood Center) was the most common specific zoning in terms of obstructions (n=30). Residential uses were second (n=24) with the most obstructed residential specific zoning type being the RM (Residential Mixed Housing) zone (n=11).

- In San José, Residential zoning types saw the highest rates of obstruction. There was a strong pattern between the density of housing and the increase of obstructions. Residential obstructions accounted for 85 out of 140 total obstructions (60.7 percent). As density increased, so did the frequency of obstructions. There were 18 obstructions recorded in the R-1-8 zone (up to eight dwelling units per acre), 25 obstructions recorded in the R-2 zone (up to two dwelling units per lot), and 38 obstructions recorded in the R-M zone (multiple dwelling units per lot). 59 out of 85 (69.4 percent) obstructions in residential zones were due to garbage cans or unbundled yard waste.

- Finally, this project looked at obstructions and their relation to MTC Equity Priority Communities (EPC), a composite indicator that measures concentrations of underserved population using demographic information such as race and income. When looking at cumulative obstructions across Oakland and San José, obstructions occurred more frequently in EPC census tracts than non-EPC census tracts. This was especially the case in San José. 71.43 percent of recorded obstructions (n=100) were in EPC census tracts. Oakland's number was less strong, with 44.19 percent of obstructions (n=38) in EPC census tracts. Both cities have EPC tracts around their downtown and spread throughout the study areas. The study areas included as even of a mix of EPC and Non-EPC tracts as possible.

Beyond the data analysis, this project conducted interviews with planners at both study cities. The purpose of these interviews was to gain contextual information on the patterns discovered through data analysis and build a stronger case for specific policy recommendations. These recommendations were shaped by information derived from the interviews. Unfortunately, all interviews were with transportation planner staff at both cities. A request to interview a representative from San José's Environmental Services Department (ESD) was initially approved, but then rescinded after the audit of their Integrated Waste Management division was presented to City Council. Given the Council direction that ESD staff strategize ways to reduce waste-related obstructions in the bike lane, the contact at ESD who was scheduled to be interviewed was instructed to hold off as the topic of this report was now an active concern of the City.

There were three categories of policy recommendations that stemmed from the interviews and data analysis: recommendations for both study cities, recommendations specific to Oakland, and recommendations specific to San José.

Those recommendations are as follows:

<u>Recommendations for both study cities:</u>

- Build more Class IV protected bike lanes
- Consider using small, narrow sweepers to sweep protected bike lanes.

Recommendations for Both Study Cities, Continued:

- Consider more permeable barriers when building protected bike lanes but scale them for objects smaller than a car.
- Consider adding a bollard at entrance points to Class IV bikeways.
- Build space for dumpsters into bikeway plans and use street infrastructure tools to create space for dumpsters and garbage cans on the street near existing bikeways.
- Create more flexible curb space in commercial areas with high frequency of deliveries.
- Educate the public on how protected bike lanes are supposed to work.
- Be creative. Design bikeways with site-specific information in mind and develop bikeway plans that allow for flexibility.

Recommendations for Oakland:

- Reconsider using parklets next to protected bike lanes or add very specific guidance and only permit parklets next to protected bike lanes in specific situations.

Recommendations for San José:

- Consider requiring yard waste to be bundled or set out in closed receptacles. End the free unbundled yard waste option for residents.
- Consider revising garbage set-out rules to allow for more flexibility as to where cans are initially placed by residents. Additionally, look to increase on-site pickup in areas with higher density housing.
- Consider using lock-to requirements for shared micromobility devices (scooters) in targeted areas of San José.

Chapter 6b: Suggestions for Further Study

This report is not an exhaustive understanding of obstructions in the bike lane, but rather a targeted study of two cities and only specific areas within those cities. Continuing this study with more resources – staffing, financing, and time – would allow for more robust results to be derived. Being able to look at an entire city as opposed to just one or two major neighborhoods would increase the likelihood of developing even stronger findings than this study. This would also hopefully cement the findings of this study as the sample size increases.

One emerging factor that may lead to successfully extending this research to a wider area is California Assembly Bill No. 361. AB 361 is an act to amend the California Vehicle Code – specifically Section 40245 of Article 3.6 of Chapter 1 of Division 17. Currently, the law authorizes the use of forward-facing cameras on transit vehicles to record possible parking violations in transit-only lanes. These recordings are subject to review by a designated employee of a city or county or contracted law enforcement agency for a special transit district. This designated employee conducts video review and can issue a citation to a parked car within 15 days of the violation.

AB 361 would amend this law to allow a local agency to "install automated forward facing parking devices on city owned or district owned *parking enforcement vehicles* for the purpose of taking photographs of *parking violations occurring in bicycle lanes.*"[152] The same review process that pertains to the transit-vehicle violations would apply to the bike lane violations.

AB 361 passed the California House and Senate and was signed into law by Governor Newsom on October 8th, 2023.[153] With budget and staff time, a city could use the technology legalized by this bill and conduct a much greater, more automated analysis of obstructions in the bike lane. Hopefully, this bill becomes law, and the City of San José effectively uses these cameras on the vehicles driven by the City's Parking and Traffic Control Officers. Interviews noted that meetings have already taken place between San José city staff, staff from other cities, and staff from the sponsor of AB 361, Assemblymember Chris Ward. Utilizing this technology would effectively allow this project to be scaled up to a much higher level and much wider scope.

Chapter 6c: Implications of this Study

This study has implications from multiple perspectives. Any city looking to reach mode shift goals needs to focus encouraging its residents to use non-automobile forms of transportation. Creating safe infrastructure for people to walk, bike, scoot, and roll is one way that cities can reach those mode shift goals. However, keeping these bike lanes free from obstructions is essential to cementing these mode shift goals and preventing potential cyclists from becoming disenchanted with riding in the city.

Street safety is also a major implication of this study. As mentioned earlier in this report, a scooter rider died earlier this year after they crashed into an unbundled yard waste pile while riding in the bike lane on Lundy Avenue in Northeast San José. Continuing to allow obstructions in the bike lane – especially unbundled yard waste obstructions which can be hard to see in low-light conditions – will continue to put cyclists at risk. Google Street View was consulted when trying to get an idea of what this section of Lundy Avenue looks like. In the street view image seen below in Figure 6.1, this section of Lundy Avenue near the intersection of Rosebriar Way is visibly obstructed by a yard waste pile in the bike lane. This image was captured by Google's street view cameras in September 2022. Clearly, the obstruction that caused a fatality earlier this year is not simply an aberration. Continuing to allow residents to place unbundled yard waste in the street has safety implications for cyclists and scooter riders who use the bike lane.

152. *AB-361 Vehicles: photographs of bicycle lane parking violations*. State of California Legislative Information. Last Updated September 11th, 2023. Accessed October 8th, 2023. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202320240AB361
153. *AB-361, 2023.*

Beyond street safety implications, continuing to allow this sort of waste to be placed in the public right-of-way has real stormwater management implications. It was made clear during data collection that even waste piles that are cleared still leave residue on the street. The specialized truck which scoops up the unbundled piles cannot possibly grab every bit of waste that is in the street. Conversations with City Infrastructure Maintenance staff revealed that what yard waste remains can wind up going into drains that flow into San José's rivers and creeks. Bundling yard waste would effectively eliminate this problem. Bags and bins can be closed shut – while the occasional bag might tear or overfilled bin might topple over, the amount of yard waste that wound up in the public right-of-way and flowing into storm drains would be dramatically decreased. This study is somewhat unique in terms of the current literature regarding bike lane infrastructure. When conducting the literature review for this report, it was hard to find articles that were focused specifically on the causes of obstructions in the bike lane, as well as to potential solutions to reduce bike lane obstructions. Much of the current literature about bike lanes is not about obstructions, but rather about the ability of a bike lane to influence mode choice or rider safety. The articles that did focus on obstructions tended to lean more towards the enforcement side - detailing apps that had been designed to report obstructions, and apps that automatically reported obstructions to municipalities. This report is not focused on enforcement - rather than, for example, reporting individuals who park in the bike lane, this report looks at the factors that may lead people to do so in the first place. This report comes at an important time for addressing safety issues in the bike lane. In Oakland, the recent tragic death of 4-year-old Maia Correia who was riding in a child seat on her father's bike has sparked outrage from residents and traffic safety advocates[154]. Correia's father was doored while riding in a painted, unprotected bike lane on Lakeshore Avenue. Maia's death has pushed the city towards developing a protected cycle track (a Class IV bikeway) on Lakeshore sooner than originally expected. There is already a similar fully protected bike lane on the west side of the lake on Lakeside Drive/Harrison Street.

154. José Fermoso, "After 4-year-old's death, Lakeshore Avenue may get a protected bike lane," *The Oaklandside*, October 20th, 2023, accessed November 6th, 2023, https://oaklandside.org/2023/10/20/maia-correia-oakland-protected-bike-lane-lakeshore-avenue/

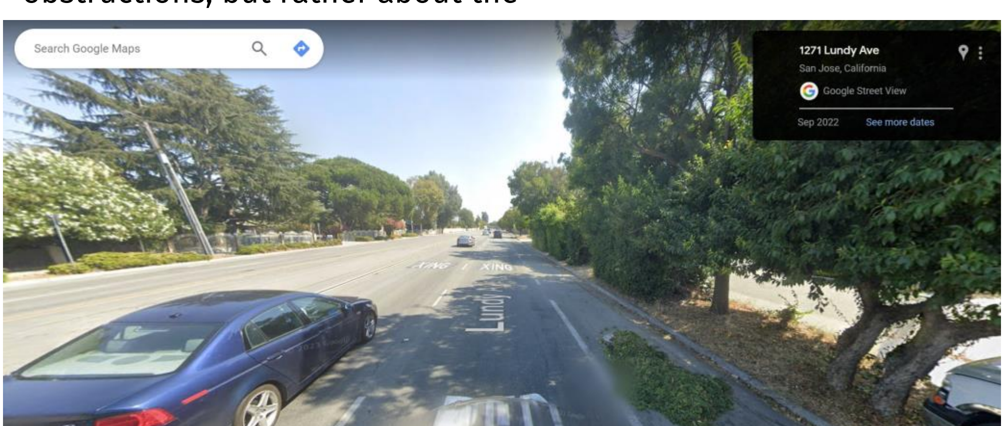

Figure 6.1: Yard waste pile in the bike lane on Lundy Avenue in San José, September 2022.

Source: Google Street View

In San José, as previously mentioned, City Council has directed Environmental Services staff to study the issue of waste cans and waste piles in the City's bike lanes - one of the key findings of this report. It is important that action is taken to address the issue of bike lane obstructions.

Obstructions are so commonplace that they are inadvertently appearing in renderings - an image from a transit plan from the City of Toronto shows a project rendering where a car is parked in a curb-separated bike lane, forcing a cyclist to ride in the street with traffic[155]. Seeing bike lane obstructions in official government documents makes it hard for many to believe that municipalities take this kind of incident seriously. This report helps with the work that proactive cities are undertaking to reverse the troubling trend of bike lane obstructions, which have legitimate safety implications for cyclists everywhere.

Chapter 6d: Closing Thoughts

Obstructions in the bike lane are only one factor that may prevent someone from riding a bike as opposed to driving. There are much greater, more common safety implications – primarily interactions between cyclists and motor vehicles. The evidence shows, however, that there are policies that cities could enact, and tactics cities could follow that would likely reduce the number of obstructions seen in their bike lanes. Policies designed to reduce obstructions may be easier to utilize than policies that are designed to make drivers slow down. Certainly, these strategies should be implemented simultaneously. Slowing down car travel speeds on city streets is crucial to making the "interested but concerned" potential ridership group referred to in both study cities' bike plans feel more comfortable riding their bike on the street. Some of these recommendations may prove to be more difficult to implement than others – reduction of obstructions is likely even if a handful of these policy suggestions were followed.

The findings and recommendations of this study provide a pathway that cities can follow to reduce bike lane obstructions. As time passes and the target years for city mode shift goals approach, it will remain to be seen whether cities truly embrace the necessary policies to encourage people to adopt alternative modes of transportation. Allocating the amount of space in the public right-of-way for private vehicles that cities currently do is not a strategy that will work years into the future. The space must be reallocated and properly managed to provide transportation options that will help cities reach their mode shift goals.

155. Ron Johnson, "Even the transit project renderings in this city have cars parked in the bike lane," *Momentum Magazine*, November 4th, 2023, accessed November 6th, 2023, https://momentummag.com/even-the-transit-project-renderings-in-this-city-have-cars-parked-in-the-bike-lane/

Figure 6.2: Barbecue in the Bike Lane, 10th Street, San José.

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Appendix A: Oakland Obstruction Data

Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Class	Number of Obstructions	Type of Obstruction	Zoning at Obstruction
37.810525	-122.269402	Friday	8/5/2022	1:48 PM	Telegraph	21st	IV	3	Parked Vehicle (Private)	CBD-C
37.787748	-122.249319	Friday	8/5/2022	7:09 PM	Embarcadero	16th Avenue	II	1	Dumped Object	M-40
37.827481	-122.268742	Friday	8/5/2022	9:55 AM	Telegraph	Apgar	IV	1	Garbage Can/Dumpster	S-15
37.843845	-122.251773	Monday	8/29/2022	3:52 PM	College	Shafter	II	1	Parked Vehicle (Private)	CN-1
37.804888	-122.2509	Monday	9/12/2022	12:11 PM	Lakeshore	Brooklyn	II	1	Parked Vehicle (Private)	OS (RSP)
37.827697	-122.265061	Friday	9/23/2022	9:36 AM	Telegraph	Apgar	IV	1	Garbage Can/Dumpster	S-15
37.83708	-122.264013	Sunday	9/25/2022	4:56 PM	Shattuck	51st	II	1	Parked Vehicle (Private)	CN-2
37.848701	-122.241772	Wednesday	9/28/2022	1:26 PM	Broadway	Brookside	IV	1	Parked Vehicle (Private)	RD-1
37.801765	-122.270656	Friday	10/7/2022	9:55 AM	11th	Webster	II	1	Parked Vehicle (Private)	CBD-C
37.832543	-122.263434	Friday	10/7/2022	7:08 PM	Telegraph	44th	IV	1	Parked Vehicle (Private)	CN-2
37.844689	-122.264748	Monday	10/10/2022	4:08 PM	59th	Shattuck	II	1	Parked Vehicle (Private)	RM-4
37.791663	-122.267977	Tuesday	10/18/2022	12:00 AM	Embarcadero	Oak	IV	1	Delivery Vehicle	R-80
37.8266	-122.284365	Tuesday	11/8/2022	8:14 AM	Hollis	34th	II	1	Dumped Object	HBX-2
37.835069	-122.262895	Friday	11/25/2022	10:07 PM	Telegraph	48th	IV	2	Construction/Street Equipment	CN-2
37.835358	-122.251151	Sunday	12/4/2022	2:32 PM	Coronado	Broadway	II	1	Parked Vehicle (Private)	CC-2
37.800665	-122.26827	Sunday	12/18/2022	10:27 AM	11th	Alice	II	1	Business Equipment	CBD-X
37.812034	-122.2795	Tuesday	1/3/2023	5:21 PM	Market	19th	II	1	Dumped Object	RM-4
37.803215	-122.236356	Wednesday	1/4/2023	4:16 PM	Park Blvd	E. 33rd St	II	1	Delivery Vehicle	RM-4
37.807343	-122.287019	Friday	2/10/2023	9:11 AM	Adeline	11th	II	1	Delivery Vehicle	RM-2
37.84393	-122.251795	Saturday	2/18/2023	3:19 PM	College	Shafter	II	1	Parked Vehicle (Private)	CN-1
37.835624	-122.262719	Saturday	2/18/2023	11:44 AM	Telegraph	49th	IV	1	Parked Vehicle (Private)	CN-2
37.798569	-122.276334	Wednesday	3/1/2023	2:27 PM	Washington	5th	II	1	Police Vehicle	C-40
37.806062	-122.293205	Tuesday	3/7/2023	10:33 PM	Mandela	8th	II	1	Garbage Can/Dumpster	RM-2
37.825045	-122.254473	Wednesday	3/15/2023	4:20 PM	Piedmont	Montell	II	1	Parked Vehicle (Private)	CN-1

Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Class	Number of Obstructions	Type of Obstruction	Zoning at Obstruction
37.827202	-122.26504	Wednesday	3/22/2023	3:07 PM	Telegraph	38th	IV	1	Parked Vehicle (Private)	CN-2
37.827375	-122.264968	Wednesday	3/22/2023	3:07 PM	Telegraph	Apgar	IV	1	Parked Vehicle (Private)	CN-2
37.846516	-122.252005	Saturday	3/25/2023	12:05 PM	College	Oak Grove	II	1	Business Equipment	CN-1
37.846676	-122.252049	Monday	3/27/2023	2:24 PM	College	Oak Grove	II	1	Delivery Vehicle	CN-1
37.811584	-122.273654	Friday	3/31/2023	9:51 AM	San Pablo	Castro	IV	1	Work Vehicle	CBD-X
37.811438	-122.273649	Friday	3/31/2023	9:51 AM	San Pablo	Castro	IV	1	Work Vehicle	CBD-X
37.803258	-122.294285	Wednesday	4/5/2023	11:39 AM	Mandela	5th	II	1	Dumped Object	S-15
37.80287	-122.294459	Wednesday	4/5/2023	11:39 AM	Mandela	3rd	II	1	Dumped Object	S-15
37.841983	-122.264778	Monday	4/24/2023	8:46 AM	Shattuck	Aileen	II	1	Work Vehicle	RM-4
37.814214	-122.268494	Thursday	4/27/2023	1:04 PM	Telegraph	25th	IV	1	Garbage Can/Dumpster	CC-2
37.816303	-122.267936	Saturday	4/29/2023	9:44 AM	Telegraph	27th	IV	1	Construction/Street Equipment	CC-2
37.789128	-122.255478	Saturday	4/29/2023	10:01 AM	Embarcadero	8th Avenue	II	1	Work Vehicle	M-40
37.829653	-122.264556	Sunday	5/7/2023	10:29 AM	Telegraph	40th	IV	1	Vegetation/Water	CN-2
37.809611	-122.269469	Wednesday	5/10/2023	2:26 PM	Telegraph	20th	IV	1	Parked Vehicle (Private)	CBD-P
37.820086	-122.266883	Wednesday	5/10/2023	3:22 PM	Telegraph	31st	II	1	Delivery Vehicle	CC-2
37.815658	-122.268028	Wednesday	5/10/2023	3:20 PM	Telegraph	26th	IV	1	Police Vehicle	CC-2
37.824756	-122.265625	Wednesday	5/10/2023	3:24 PM	Telegraph	36th	II	1	Parked Vehicle (Private)	CN-2
37.809894	-122.286106	Thursday	5/18/2023	11:18 PM	Adeline	14th	II	1	Delivery Vehicle	RM-4
37.835964	-122.262519	Tuesday	6/6/2023	9:55 PM	Telegraph	49th	IV	1	Construction/Street Equipment	CN-2
37.828721	-122.264527	Wednesday	6/7/2023	4:00 PM	Telegraph	39th	IV	1	Parked Vehicle (Private)	CN-2
37.828278	-122.2499	Sunday	6/11/2023	10:18 AM	Piedmont	Glenwood	II	1	Parked Vehicle (Private)	CN-1
37.828612	-122.264707	Monday	6/12/2023	10:02 AM	Telegraph	39th	IV	1	Work Vehicle	S-15
37.814084	-122.262657	Wednesday	6/14/2023	10:10 AM	27th	Broadway	IV	1	Garbage Can/Dumpster	RU-4
37.838514	-122.275543	Thursday	6/15/2023	7:10 PM	Adeline	54th	II	1	Parked Vehicle (Private)	HBX-1

Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Class	Number of Obstructions	Type of Obstruction	Zoning at Obstruction
37.815019	-122.268297	Monday	6/19/2023	9:45 AM	Telegraph	Sycamore	IV	1	Parked Vehicle (Private)	CC-2
37.801356	-122.270047	Tuesday	6/20/2023	6:09 PM	11th	Webster	II	1	Delivery Vehicle	CBD-C
37.797377	-122.264501	Thursday	6/22/2023	6:14 PM	9th	Oak	II	1	Parked Vehicle (Private)	CBD-X
37.821503	-122.26657	Monday	6/26/2023	9:51 AM	Telegraph	33rd	II	1	Delivery Vehicle	CC-2
37.789201	-122.256611	Monday	7/3/2023	10:05 AM	Embarcadero	7th Ave	II	1	Parked Vehicle (Private)	M-40
37.791624	-122.267733	Monday	7/3/2023	10:02 AM	Embarcadero	Oak	IV	1	Delivery Vehicle	R-80
37.79737	-122.262207	Monday	7/3/2023	7:17 PM	10th	Fallon	II	1	Construction/Street Equipment	S-2
37.797984	-122.264809	Wednesday	7/5/2023	3:43 PM	Oak	10th	II	1	Parked Vehicle (Private)	CBD-R
37.815299	-122.26422	Wednesday	7/5/2023	3:52 PM	Broadway	27th	II	1	Police Vehicle	CC-2
37.813516	-122.268557	Thursday	7/6/2023	6:22 PM	Telegraph	24th	IV	1	Delivery Vehicle	CC-2
37.802527	-122.261967	Tuesday	7/11/2023	5:39 PM	Lakeside	15th	II	1	Parked Vehicle (Private)	OS (RSP)
37.836763	-122.259324	Sunday	7/16/2023	9:56 AM	51st	Webster	II	1	Parked Vehicle (Private)	RM-1
37.80469	-122.25077	Sunday	7/16/2023	1:59 PM	Lakeshore	Brooklyn	II	1	Delivery Vehicle	RU-3
37.829745	-122.26428	Tuesday	7/18/2023	6:29 PM	Telegraph	41st	IV	1	Work Vehicle	CN-2
37.840401	-122.265568	Wednesday	7/19/2023	12:07 PM	55th	Shattuck	II	1	Delivery Vehicle	RM-2
37.807754	-122.270056	Tuesday	7/25/2023	6:38 PM	Telegraph	18th	II	1	Work Vehicle	CBD-P
37.843597	-122.251737	Tuesday	7/25/2023	7:43 PM	College	Shafter	II	1	Parked Vehicle (Private)	CN-1
37.819846	-122.261449	Wednesday	7/26/2023	4:43 PM	Broadway	30th	II	1	Dumpster/Garbage Can	CC-2
37.827165	-122.265076	Wednesday	7/26/2023	2:26 PM	Telegraph	38th	IV	1	Police Vehicle	CN-2
37.828312	-122.249889	Sunday	7/30/2023	4:24 PM	Piedmont	Glenwood	II	1	Parked Vehicle (Private)	CN-1
37.836385	-122.26248	Sunday	7/30/2023	4:35 PM	Telegraph	49th	IV	1	Parked Vehicle (Private)	CN-2
37.818587	-122.267345	Wednesday	8/9/2023	1:34 PM	Telegraph	29th	II	1	Delivery Vehicle	CC-2
37.826304	-122.265286	Wednesday	8/9/2023	1:32 PM	Telegraph	MacArthur	II	1	Work Vehicle	CN-2
37.831488	-122.263874	Wednesday	8/9/2023	1:30 PM	Telegraph	43rd	IV	1	Work Vehicle	CN-2

Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Class	Number of Obstructions	Type of Obstruction	Zoning at Obstruction
37.806766	-122.266726	Thursday	8/24/2023	2:19 PM	Webster	19th	II	1	Parked Vehicle (Private)	CBD-P
37.803274	-122.268926	Thursday	8/24/2023	2:21 PM	Webster	14th	II	1	Parked Vehicle (Private)	CBD-P
37.824876	-122.254492	Monday	8/28/2023	1:08 PM	Piedmont	Montell	II	1	Construction/Street Equipment	CN-1
37.827048	-122.251527	Monday	8/28/2023	2:38 PM	Piedmont	Linda	II	1	Delivery Vehicle	CN-1
37.828252	-122.249942	Monday	8/28/2023	2:38 PM	Piedmont	Glenwood	II	1	Parked Vehicle (Private)	CN-1
37.836843	-122.264082	Monday	8/28/2023	11:51 AM	Shattuck	50th	II	1	Delivery Vehicle	CN-3
37.83505	-122.263769	Monday	8/28/2023	11:52 AM	Shattuck	48th	II	1	Delivery Vehicle	CN-3
37.838113	-122.264238	Monday	8/28/2023	11:50 AM	Shattuck	52nd	II	1	Parked Vehicle (Private)	CN-4
37.823878	-122.255808	Monday	8/28/2023	1:09 PM	Piedmont	Yosemite	II	1	Parked Vehicle (Private)	D-KP-3
37.829298	-122.264633	Tuesday	8/29/2023	10:35 AM	40th	Telegraph	II	2	Dumpster/Garbage Can	CN-2
37.80804	-122.249447	Wednesday	8/30/2023	1:54 PM	Lakeshore	El Embarcadero	II	1	Parked Vehicle (Private)	OS (RSP)
37.841346	-122.264618	Wednesday	8/30/2023	6:26 PM	Shattuck	56th	II	1	Parked Vehicle (Private)	RM-4

Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Class	Number of Obstructions	Type of Obstruction	Zoning at Obstruction
37.33757	-121.8831	Thursday	4/7/2022	7:24 PM	San Fernando	7th	IV	1	Police Vehicle	DC
37.34377	-121.8875	Wednesday	4/20/2022	3:47 PM	7th	Julian	II	3	Unbundled Yard Waste	R-1-8
37.34391	-121.8834	Tuesday	8/23/2022	3:27 PM	10th	St. James	IV	1	Vegetation/Water	R-2
37.34657	-121.8765	Thursday	8/25/2022	3:25 PM	17th	St. James	II	14	Dumpster/Garbage Can	R-2
37.35387	-121.8783	Tuesday	8/30/2022	3:02 PM	Empire	20th	II	1	Unbundled Yard Waste	R-1-8
37.33442	-121.8768	Thursday	9/1/2022	3:19 PM	San Salvador	10th	IV	1	Parked Vehicle (Private)	PQP
37.33241	-121.8811	Tuesday	9/13/2022	1:06 PM	San Salvador	6th	IV	1	Parked Vehicle (Private)	PQP
37.34657	-121.8897	Thursday	9/22/2022	11:57 AM	7th	Washington	II	1	Dumped Object	R-M
37.34358	-121.8749	Thursday	10/20/2022	6:29 PM	17th	Santa Clara	II	1	Dumped Object	CN
37.36307	-121.875	Thursday	10/27/2022	8:47 AM	Mabury	Taylor	IV	1	Parked Vehicle (Private)	LI
37.33382	-121.8848	Thursday	11/3/2022	10:52 AM	4th	Paseo De San Antonio	II	1	Parked Vehicle (Private)	CG(PD)
37.33651	-121.8779	Thursday	11/10/2022	12:29 PM	10th	San Carlos	IV	1	Parked Vehicle (Private)	UR
37.34216	-121.8821	Thursday	12/15/2022	8:58 AM	10th	St. John	IV	1	Dumped Object	R-M
37.33736	-121.8885	Tuesday	1/3/2023	12:13 PM	3rd	Santa Clara	IV	2	Dumpster/Garbage Can	DC
37.33876	-121.8756	Thursday	1/12/2023	5:09 PM	13th	San Antonio	IV	1	Shared Scooter	R-1-8
37.35112	-121.8899	Tuesday	1/17/2023	1:52 PM	Jackson St.	9th	II	2	Dumpster/Garbage Can	R-1-8
37.33678	-121.8844	Thursday	1/19/2023	12:54 PM	San Fernando	6th	IV	1	Parked Vehicle (Private)	DC
37.36138	-121.8766	Thursday	1/19/2023	8:51 AM	Taylor	US-101	IV	1	Vegetation/Water	LI
37.35472	-121.8762	Tuesday	1/31/2023	5:32 PM	Empire	22nd	II	1	Dumped Object	R-1-8
37.3496	-121.8761	Tuesday	1/31/2023	5:30 PM	19th	Julian	II	4	Dumpster/Garbage Can	R-2
37.35009	-121.8861	Tuesday	1/31/2023	8:55 AM	Empire	12th	II	1	Parked Vehicle (Private)	R-2
37.33592	-121.8862	Monday	2/6/2023	3:12 PM	4th	San Fernando	IV	1	Dumped Object	A(PD)
37.33146	-121.8858	Monday	2/6/2023	2:20 PM	2nd	San Carlos	IV	1	Dumpster/Garbage Can	DC
37.32945	-121.8835	Monday	2/6/2023	3:10 PM	3rd	William	IV	1	Unbundled Yard Waste	DC

Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Class	Number of Obstructions	Type of Obstruction	Zoning at Obstruction
37.3362	-121.8853	Monday	2/6/2023	3:13 PM	San Fernando	5th	IV	1	Parked Vehicle (Private)	PQP
37.33617	-121.9211	Monday	2/6/2023	1:39 PM	Naglee	Morse	II	1	Delivery Vehicle	R-1-8
37.33679	-121.9273	Monday	2/6/2023	1:37 PM	Park Ave.	Hedding	II	3	Dumpster/Garbage Can	R-M
37.3488	-121.8887	Monday	2/13/2023	3:25 PM	Empire	9th	II	8	Dumpster/Garbage Can	PQP
37.35463	-121.8764	Monday	2/13/2023	3:19 PM	Empire	22nd	II	1	Dumpster/Garbage Can	R-1-8
37.33539	-121.8871	Tuesday	2/14/2023	5:27 PM	San Fernando	3rd	IV	1	Parked Vehicle (Private)	A(PD)
37.35466	-121.8774	Thursday	2/16/2023	7:27 PM	21st	Empire	II	1	Unbundled Yard Waste	R-1-8
37.33314	-121.8841	Tuesday	2/28/2023	3:34 PM	4th	San Carlos	IV	1	Shared Scooter	CG
37.33203	-121.8831	Tuesday	2/28/2023	3:29 PM	4th	San Salvador	IV	1	Shared Scooter	PQP
37.33202	-121.8831	Tuesday	2/28/2023	3:30 PM	4th	San Salvador	IV	1	Shared Scooter	PQP
37.34377	-121.8877	Monday	3/6/2023	3:52 PM	7th	Julian	II	1	Unbundled Yard Waste	R-M
37.33739	-121.8827	Tuesday	3/7/2023	1:30 PM	San Fernando	7th	IV	1	Shared Scooter	PQP
37.34629	-121.8814	Wednesday	3/8/2023	12:40 PM	13th	Julian	II	1	Unbundled Yard Waste	R-1-8
37.33945	-121.8602	Thursday	3/23/2023	2:56 PM	McLaughlin	Spiro Dr.	IV	1	Dumpster/Garbage Can	R-1-8
37.34594	-121.8611	Thursday	3/23/2023	3:45 PM	San Antonio	28th	II	1	Unbundled Yard Waste	R-2
37.34156	-121.8859	Monday	4/3/2023	3:41 PM	7th	St. James	II	9	Dumpster/Garbage Can	R-M
37.33778	-121.8818	Tuesday	4/4/2023	2:24 PM	San Fernando	8th	IV	1	Shared Scooter	PQP
37.33745	-121.8825	Tuesday	4/4/2023	2:24 PM	San Fernando	7th	IV	1	Delivery Vehicle	PQP
37.33373	-121.8845	Thursday	4/6/2023	3:13 PM	4th	San Carlos	IV	1	Police Vehicle	CG
37.34965	-121.8876	Monday	4/10/2023	1:10 PM	10th	Empire	II	1	Dumped Object	PQP
37.33437	-121.8947	Wednesday	4/12/2023	1:39 PM	Notre Dame	Santa Clara	II	1	Construction/Street Equipment	DC
37.33837	-121.8943	Wednesday	4/12/2023	9:01 AM	10th	St. James	IV	1	Shared Scooter	DC
37.33156	-121.8858	Thursday	4/13/2023	2:13 PM	2nd	San Carlos	IV	1	Dumpster/Garbage Can	DC
37.34753	-121.8861	Monday	4/24/2023	10:39 AM	10th	Washington	IV	1	Dumpster/Garbage Can	R-2

Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Class	Number of Obstructions	Type of Obstruction	Zoning at Obstruction
37.33228	-121.9002	Wednesday	4/26/2023	11:17 AM	Barack Obama	Santa Clara	IV	1	Shared Scooter	OS
37.33236	-121.9002	Wednesday	4/26/2023	11:19 AM	Barack Obama	Santa Clara	IV	1	Shared Scooter	OS
37.33239	-121.9002	Wednesday	4/26/2023	11:19 AM	Barack Obama	Santa Clara	IV	1	Shared Scooter	OS
37.3498	-121.8867	Monday	5/1/2023	3:08 PM	Empire	11th	II	1	Parked Vehicle (Private)	PQP
37.34994	-121.8861	Monday	5/1/2023	3:07 PM	Empire	11th	II	2	Parked Vehicle (Private)	R-2
37.33189	-121.903	Monday	5/8/2023	1:57 PM	Santa Clara	Cahill	II	1	Dumped Object	DC
37.33358	-121.8787	Tuesday	5/9/2023	3:12 PM	San Salvador	8th	IV	1	Shared Scooter	PQP
37.33766	-121.8774	Tuesday	5/9/2023	3:23 PM	11th	San Antonio	IV	1	Parked Vehicle (Private)	UR
37.3643	-121.8309	Thursday	5/11/2023	11:35 AM	Alum Rock	White	II	1	Parked Vehicle (Private)	CN
37.35616	-121.8411	Thursday	5/11/2023	11:35 AM	Jackson Ave.	San Antonio	II	1	Delivery Vehicle	CP
37.36015	-121.8451	Thursday	5/11/2023	10:27 AM	Jackson Ave.	Luz	II	1	Work Vehicle	R-M
37.3476	-121.8905	Monday	5/15/2023	3:39 PM	7th	Empire	II	14	Dumpster/Garbage Can	A(PD)
37.3434	-121.8874	Monday	5/15/2023	3:42 PM	7th	Julian	II	7	Dumpster/Garbage Can	CG
37.3494	-121.8874	Monday	5/15/2023	3:39 PM	Empire	10th	II	9	Dumpster/Garbage Can	PQP
37.3457	-121.889	Monday	5/15/2023	3:41 PM	7th	Washington	II	17	Dumpster/Garbage Can	R-M
37.3424	-121.8866	Monday	5/15/2023	3:42 PM	7th	St. James	II	16	Dumpster/Garbage Can	R-M
37.33298	-121.8842	Wednesday	5/17/2023	1:34 PM	San Carlos	4th	II	2	Parked Vehicle (Private)	CG
37.34534	-121.8807	Wednesday	5/17/2023	11:28 AM	13th	St. James	II	1	Parked Vehicle (Private)	R-M
37.3366	-121.8846	Thursday	5/18/2023	8:58 AM	San Fernando	5th	IV	1	Parked Vehicle (Private)	DC
37.34759	-121.886	Thursday	6/1/2023	9:09 AM	10th	Washington	IV	1	Unbundled Yard Waste	R-2
37.3439	-121.8835	Thursday	6/1/2023	9:10 AM	10th	St. James	IV	1	Unbundled Yard Waste	R-2
37.34622	-121.8894	Thursday	6/1/2023	5:42 PM	7th	Washington	II	1	Unbundled Yard Waste	R-M
37.34021	-121.8865	Tuesday	6/6/2023	9:00 AM	St. John	6th	III	1	Parked Vehicle (Private)	MUC
37.3601	-121.8783	Tuesday	6/6/2023	8:48 AM	Taylor	23rd	IV	1	Shared Scooter	MUN

Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Class	Number of Obstructions	Type of Obstruction	Zoning at Obstruction
37.34152	-121.8859	Tuesday	6/6/2023	8:59 AM	7th	St. John	II	5	Dumpster/Garbage Can	R-M
37.34191	-121.8863	Tuesday	6/6/2023	8:58 AM	7th	St. James	II	2	Dumpster/Garbage Can	R-M
37.34581	-121.8949	Saturday	6/17/2023	7:36 PM	Empire	3rd	II	7	Unbundled Yard Waste	R-M
37.33288	-121.8844	Tuesday	6/18/2023	10:46 AM	San Carlos	4th	II	1	Parked Vehicle (Private)	CG
37.35396	-121.8777	Tuesday	6/18/2023	5:02 PM	Empire	20th	II	2	Dumpster/Garbage Can	R-1-8
37.34338	-121.8945	Tuesday	6/20/2023	4:43 PM	2nd	Hensley	II	1	Unbundled Yard Waste	R-M
37.34937	-121.8876	Thursday	6/22/2023	9:07 AM	10th	Empire	IV	1	Unbundled Yard Waste	R-2
37.34721	-121.886	Thursday	6/22/2023	9:09 AM	10th	Washington	IV	1	Unbundled Yard Waste	R-2
37.34095	-121.8855	Thursday	6/22/2023	5:03 PM	7th	St. John	II	1	Construction/Street Equipment	R-M
37.34461	-121.8882	Thursday	6/22/2023	5:05 PM	7th	Washington	II	1	Unbundled Yard Waste	R-M
37.34461	-121.8882	Thursday	6/22/2023	5:06 PM	7th	Washington	II	1	Unbundled Yard Waste	R-M
37.34061	-121.8853	Tuesday	6/27/2023	9:02 AM	7th	St. John	II	1	Dumpster/Garbage Can	DC
37.33398	-121.8901	Tuesday	6/27/2023	3:23 PM	San Fernando	1st	II	1	Parked Vehicle (Private)	DC
37.33168	-121.8858	Tuesday	6/27/2023	3:29 PM	2nd	San Carlos	IV	1	Dumpster/Garbage Can	DC
37.3488	-121.8886	Tuesday	6/27/2023	8:58 AM	Empire	9th	II	4	Dumpster/Garbage Can	R-2
37.34914	-121.8878	Tuesday	6/27/2023	8:58 AM	Empire	10th	II	2	Dumpster/Garbage Can	R-2
37.34315	-121.8871	Tuesday	6/27/2023	9:01 AM	7th	Julian	II	3	Dumpster/Garbage Can	R-M
37.34084	-121.8854	Tuesday	6/27/2023	9:02 AM	7th	St. John	II	3	Dumpster/Garbage Can	R-M
37.34932	-121.8835	Tuesday	6/27/2023	5:17 PM	13th	Washington	II	3	Dumpster/Garbage Can	R-M
37.34669	-121.8897	Tuesday	6/27/2023	9:00 AM	7th	Washington	II	2	Dumpster/Garbage Can	R-M
37.34519	-121.8886	Tuesday	6/27/2023	9:00 AM	7th	Washington	II	2	Dumpster/Garbage Can	R-M
37.34218	-121.8865	Tuesday	6/27/2023	9:02 AM	7th	St. James	II	2	Dumpster/Garbage Can	R-M
37.34197	-121.8862	Tuesday	6/27/2023	9:02 AM	7th	St. James	II	2	Dumpster/Garbage Can	R-M
37.34101	-121.8855	Tuesday	6/27/2023	9:02 AM	7th	St. John	II	2	Dumpster/Garbage Can	R-M

Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Class	Number of Obstructions	Type of Obstruction	Zoning at Obstruction
37.34519	-121.8886	Tuesday	6/27/2023	9:00 AM	7th	Washington	II	1	Dumpster/Garbage Can	R-M
37.34416	-121.8879	Tuesday	6/27/2023	9:00 AM	7th	Julian	II	1	Unbundled Yard Waste	R-M
37.34315	-121.8871	Tuesday	6/27/2023	9:01 AM	7th	Julian	II	1	Dumpster/Garbage Can	R-M
37.34288	-121.887	Tuesday	6/27/2023	9:01 AM	7th	Julian	II	1	Unbundled Yard Waste	R-M
37.33597	-121.8862	Thursday	6/29/2023	2:08 PM	4th	San Fernando	IV	1	Parked Vehicle (Private)	A(PD)
37.35246	-121.881	Thursday	6/29/2023	9:07 AM	Empire	17th	II	1	Delivery Vehicle	CP
37.33873	-121.8883	Thursday	6/29/2023	2:29 PM	4th	St. John	II	1	Parked Vehicle (Private)	DC
37.35337	-121.8791	Thursday	6/29/2023	9:07 AM	Empire	19th	II	1	Construction/Street Equipment	R-1-8
37.33294	-121.8843	Wednesday	7/5/2023	1:36 PM	San Carlos	4th	II	1	Parked Vehicle (Private)	CG
37.35134	-121.8833	Tuesday	7/11/2023	8:51 AM	Empire	14th	II	1	Work Vehicle	OS
37.3383	-121.8861	Thursday	7/13/2023	12:30 PM	San Fernando	5th	IV	1	Shared Scooter	PQP
37.35419	-121.8773	Thursday	7/13/2023	9:17 AM	Empire	21st	II	1	Work Vehicle	R-1-8
37.34608	-121.8811	Thursday	7/13/2023	4:27 PM	13th	Julian	II	5	Dumpster/Garbage Can	R-M
37.34444	-121.8798	Thursday	7/13/2023	4:27 PM	13th	St. James	II	2	Dumpster/Garbage Can	R-M
37.34496	-121.8885	Thursday	7/13/2023	9:24 AM	7th	Washington	II	1	Dumpster/Garbage Can	R-M
37.34417	-121.8879	Thursday	7/13/2023	9:24 AM	7th	Julian	II	1	Unbundled Yard Waste	R-M
37.34147	-121.8859	Thursday	7/13/2023	9:25 AM	7th	St. James	II	1	Dumpster/Garbage Can	R-M
37.34523	-121.8804	Thursday	7/13/2023	4:27 PM	13th	St. James	II	1	Parked Vehicle (Private)	R-M
37.35035	-121.8533	Thursday	7/20/2023	1:45 PM	King	San Antonio	II	5	Dumpster/Garbage Can	R-1-8
37.36074	-121.8634	Thursday	7/20/2023	2:26 PM	King	Schulte	II	1	Construction/Street Equipment	R-1-8
37.35468	-121.8575	Thursday	7/20/2023	2:30 PM	King	Wilshire	II	1	Dumpster/Garbage Can	R-2
37.35409	-121.8569	Thursday	7/20/2023	2:30 PM	King	Beverly	II	1	Dumpster/Garbage Can	R-2
37.3476	-121.8847	Thursday	7/20/2023	5:24 PM	11th	Washington	IV	1	Unbundled Yard Waste	R-2
37.35241	-121.8553	Thursday	7/20/2023	2:31 PM	King	Alum Rock	II	1	Dumpster/Garbage Can	UV

Latitude	Longitude	Day of Week	Date	Time	Street	Nearest Cross Street	Bike Lane Class	Number of Obstructions	Type of Obstruction	Zoning at Obstruction
37.3329	-121.8843	Thursday	7/27/2023	2:08 PM	San Carlos	4th	II	1	Parked Vehicle (Private)	CG
37.34002	-121.8848	Thursday	7/27/2023	5:07 PM	7th	St. John	II	1	Parked Vehicle (Private)	R-M
37.34738	-121.8903	Tuesday	8/1/2023	5:30 PM	7th	Empire	II	1	Parked Vehicle (Private)	A(PD)
37.34761	-121.8904	Tuesday	8/1/2023	5:30 PM	7th	Empire	II	1	Parked Vehicle (Private)	R-1-8
37.33033	-121.8976	Tuesday	8/1/2023	2:45 PM	San Fernando	Delmas	II	2	Construction/Street Equipment	R-2
37.34906	-121.888	Tuesday	8/1/2023	5:31 PM	Empire	9th	II	1	Parked Vehicle (Private)	R-2
37.35209	-121.8816	Tuesday	8/1/2023	5:34 PM	Empire	16th	II	1	Dumpster/Garbage Can	R-2
37.34936	-121.8876	Tuesday	8/1/2023	8:55 AM	10th	Empire	IV	1	Unbundled Yard Waste	R-2
37.34198	-121.8862	Tuesday	8/1/2023	5:27 PM	7th	St. James	II	1	Dumpster/Garbage Can	R-M
37.35271	-121.8803	Tuesday	8/8/2023	9:10 AM	Empire	18th	II	2	Dumpster/Garbage Can	R-1-8
37.35278	-121.881	Tuesday	8/8/2023	5:28 PM	17th	Empire	II	2	Dumpster/Garbage Can	R-2
37.35265	-121.8809	Wednesday	8/16/2023	5:38 PM	17th	Empire	II	1	Unbundled Yard Waste	CP
37.35236	-121.8807	Wednesday	8/16/2023	5:38 PM	17th	Empire	II	1	Unbundled Yard Waste	R-1-8
37.35012	-121.8857	Wednesday	8/16/2023	9:10 AM	Empire	12th	II	1	Construction/Street Equipment	R-2
37.3455	-121.8832	Thursday	8/17/2023	5:34 PM	11th	Julian	IV	1	Dumpster/Garbage Can	R-2
37.34097	-121.8813	Thursday	8/24/2023	3:39 PM	10th	Santa Clara	IV	1	Dumpster/Garbage Can	CG
37.34749	-121.8771	Thursday	8/24/2023	7:23 PM	17th	Julian	II	3	Dumpster/Garbage Can	R-2
37.34598	-121.876	Thursday	8/24/2023	7:22 PM	17th	St. James	II	2	Dumpster/Garbage Can	R-2
37.34589	-121.881	Thursday	8/24/2023	3:37 PM	13th	St. James	II	1	Parked Vehicle (Private)	R-M
37.33551	-121.8866	Tuesday	8/29/2023	6:26 PM	San Fernando	4th	IV	1	Shared Scooter	A(PD)

Appendix C: List of Online Databases, Catalogs, and Keywords Searched for Literature Review

Below is a list of the online databases and the keywords used to find the articles for the Literature Review for this project. Additional articles were found by looking at the referenced works within the literature. These were cross-referenced with the King Library OneSearch tool to check the provenance of the journal (and whether it was peer-reviewed).

- SJSU King Library OneSearch
  - Bike lane obstructions
  - Bike lane obstructions Manhattan
  - Flexible curb space
  - Municipal programs traffic violation
  - Bike lane obstacle
  - Blocking bike lane
  - Curb space bike
  - Obstruction bike lane
  - Curb space
  - Bike lane
  - Bike lane conflict
  - Bike lanes
  - Curb management
  - Protected bike lane
  - Obstruction bike lane

- Google Scholar
  - Bike lane conflicts
  - Multimodal conflicts
  - Bike lane enforcement
  - Protected bike lanes
  - Bike lane obstructions

- Transportation Research International Documentation (TRID)
  - Bike lane
  - Bike lane safety
  - Bike lane obstruction
  - Separated bike lanes
  - Protected bike lanes