Title

Re-Inventing the Bus Stop: Design Guidelines and Analysis for Transit-Friendly Parklets in Alameda County

Author

Kaufman, Ben

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Design Guidelines and Analysis for Transit-Friendly Parklets in Alameda County

A Research Paper by Ben Kaufman

Candidate for Master's in Urban Planning at the UCLA Luskin School of Public Affairs

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Re-Inventing the Bus Stop:

Design Guidelines and Analysis for Transit-Friendly Parklets in Alameda County

Ben Kaufman

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Client: Alameda-Contra Costa Transit District (AC Transit)

Client Representative: Stephen Newhouse

Faculty Advisor: Anastasia Loukaitou-Sideris

Disclaimer:

Abstract

The Alameda-Contra Costa Transit District (AC Transit) is a public transportation agency in Alameda County, California that serves almost 200,000 bus riders per day. Like many transit agencies in the United States, most bus stops throughout its system lack basic amenities such as seating, shelter, lighting, and system information. The absence of such amenities can lead to unpleasant waiting experiences, and make it increasingly difficult for the agency to retain existing ridership and encourage new system users.

Meanwhile, parklets have become an increasingly popular phenomenon in US cities since their inception in 2010. Parklets are privately driven public sidewalk extensions that frequently include many of the amenities that bus stops often lack, at no cost to the public. Despite their parallels, existing guidelines prohibit the installation of parklets at public bus stop locations. This paper explores the idea of combining these two urban facilities. The paper's literature review outlines the benefits and limitations of both bus stops and parklets, the meta-analysis addresses the similarities and differences between the two treatments, and the suitability analysis considers where in Alameda County they can and should be located based on geographic, demographic, and land use data. After acknowledging potential challenges, the paper ultimately recommends AC Transit pursue the implementation of a hybrid bus stop-parklet pilot program to improve the comfort, convenience, safety, and security of riders throughout its system.

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Introduction

This research paper aims to provide city employees, business owners, and communities around Alameda County, California, and the entire world with a practical guide to implementing a new type of bus stop that builds upon the success of parklets and creates a space for transit riders, business customers, and community members to enjoy, whether they are waiting for their bus, drinking a cup of coffee, or talking to their neighbor. Through this new design intervention, bus stops have the potential to become active spaces that benefit their users, proximate businesses, the local transit agency, and the city and region as a whole. This paper details this design concept, its history, benefits, and challenges, and ultimately provides advice on design guidelines, ideal locations for implementation in Oakland and Berkeley, and other recommendations on how to ensure project success.

RE-INVENTING THE BUS STOP: AN OPPORTUNITY

Nobody likes to wait for the bus. Passengers consistently rank the waiting experience as one of their top dissatisfactions with public transit (Friman, 2008), and the main motivation behind abandoning public transit altogether, for those who do (Andre Carrel, 2013). For years, transit agencies have worked to reduce wait times through more frequent service, publicly available schedule information, and real-time transit geo-location technologies. And yet even today, wherever public transit can be found, transit riders can also be found waiting at stops and stations for a bus or train arrive.

Because of congestion, unpredictable accidents, untimed transfers, and low-density corridors for which high frequency service is not cost-beneficial, the waiting experience is not likely to go away any time soon. So in lieu of completely eliminating the customer waiting experience, what can transit agencies do to improve it? In recent years, several US cities have tried to answer this question by providing local bus stop improvement programs. Such programs aim to improve the waiting experience through the installation of amenities, including benches, shelters, trash receptacles, curb extensions, bus schedules and other route information (Bus Stop Improvement Project, 2015) (Key Bus Route Improvement Program, 2015) (Bus Stop Enhancement Project, 2015).

But these programs can be costly to implement. In a 2012 evaluation of bus stop improvement costs along International Boulevard in Oakland, AC Transit estimated that the capital cost for improved bus stop amenities would amount to $15.2 million for 24 stops, or roughly $633,000 per stop, before accounting for annual maintenance costs (AC Transit East Bay Bus Rapid Transit Project, 2012). These amenities don't necessarily even reflect what transit riders are seeking in bus stop improvements. In a 2012 study on the bus stop waiting experience, researchers found riders to be least satisfied with the lack of access to a public restroom, the inability to get help in an emergency, limited seating, a feeling of vulnerability, and the lack of proximate places with food or beverages (Hiroyuki Iseki, 2012). Of all of the improvements made through the aforementioned city-sponsored bus stop improvement programs, only benches address these respondents' displeasures.

While this presents a challenge for transit agencies, it also presents an opportunity – with the help of other agencies, businesses, non-profits, and the communities they serve – to innovate on an urban amenity that has remained relatively unchanged since the advent of the electric streetcar in the late 19th century (Bignardi, 2014). This paper seeks to jumpstart this innovation by juxtaposing the sluggish modernization of the bus stop against a rapidly evolving urban amenity known as the *parklet*, and highlighting opportunities for integration between the two.

WHAT IS A PARKLET?

A parklet is a small curbside public space that provides seating and other amenities to local business customers and neighborhood residents (see Figure 1). Its history dates back to 2005 when Rebar, a small design studio out of San Francisco, fed the meter of a nearby downtown parking space and converted it into a temporary mini-park. A photograph of the intervention went viral and an annual holiday celebrating the reinvention of on-street parking spaces was born. Only four years after the publicity stunt took place, the City of San Francisco established the world's first parklet program (About Park(ing) Day, 2012), which has since led to the installation of over 50 parklets throughout the city and inspired hundreds more throughout the world (Parklets, Plazas and Temporary Programs & Projects Outside of San Francisco, 2015).

Figure 1: Parklet Rendering

(Urban Street Design Guide: Parklets, 2015)

The parklet emerged as part of a burgeoning phenomenon in US urban environments known as *tactical urbanism.* Tactical urbanism is a community-driven approach to urban design that focuses on small-scale, low-cost, and mostly temporary public space improvements (Pfeifer, 2013). These changes are often made without city approval, with city responses ranging from their immediate disassembly to the establishment of entire programs dedicated to their replication. Parklets survived the initial test of public scrutiny and continue to enjoy widespread support to this day.

WHAT IS A BUS BULB OUT?

A bus bulb out (also known as a *bus bulb*, *bus nub*, *bus boarder*, or *bus stop curb extension*) is a curbside bus stop whose sidewalk is extended to the edge of the parking lane, making bus trips faster and more reliable by enabling buses to pick up and drop off passengers without having to leave the travel lane (see Figure 2). They typically create enough additional sidewalk space to allow for the installation of bus shelters and other amenities that improve the customer waiting experience without impeding pedestrian traffic flow. They have the added benefit of shortening the walking distance from one side of the street to the other, thereby reducing pedestrian exposure to vehicular traffic.

Figure 2: Bus Bulb Rendering

(Urban Street Design Guide: Bus Bulbs, 2015)

The bus bulb's history in the Bay Area dates back to 1972, when San Francisco's Planning Department adopted a policy calling for the improvement of transit travel speed and service frequency by prioritizing public transit vehicles on several streets (Callwell, 1999). This policy became known as the Transit Preferential Streets Plan and specifically called for several transit improvements, including the construction of bus bulbs and transit islands throughout the city. In 1974, the San Francisco Municipal Railway constructed bus bulbs and transit islands along Polk Street, Mission Street, and Fourth Street. After proving a successful strategy to increase transit efficiency and reliability, the agency expanded the program to several other streets throughout the city (Committee, 1989), and they can now be found along most transit routes in San Francisco and, more recently, at several bus stop locations throughout the East Bay (Knobel, 2012).

WHAT IS A STOPLET?

A stoplet is a proposed street treatment that combines the principles of good bus stop and parklet design. The concept creates a temporary sidewalk extension through a partnership between a local transit agency and a business adjacent to a bus stop in that agency's jurisdiction. This space would function as both a public space and a transit stop, providing seating, shelter, and other amenities to transit riders, business customers, and neighborhood residents alike. By creating a shared vision between the transit agency and local business, this concept has the potential to create a low-cost, safe, comfortable, innovative, and well-maintained alternative to the existing bus stop that can simultaneously improve an area's economic vitality, transit customer satisfaction, and a local sense of community.

While no such street treatment currently exists, there are several tactical urban interventions at bus stops throughout the world that validate the stoplet concept. The first is London's *Edible Bus Stop* project, a community-driven effort to transform neglected sites across London's bus network into valuable community gardening spaces. This project began as a response to the city's plan to sell a treasured bus stop-adjacent green space to a private developer. A group of community activists protested by creating a community garden in its place, and after receiving positive feedback, replicated the idea at other bus stop-adjacent spaces throughout London (Jamieson, 2012). Shortly thereafter, the gardens were officially approved by the city government, and have since inspired London's Pocket Park Programme (Murphy-Evans, 2015), which was established by the Mayor in 2013 and now boasts over 40 pocket parks throughout the city (Pocket Park Projects, 2015).

Other community activists around the world have installed their own bus stop amenities that have yet to be endorsed by their local government. In Los Angeles, a group of guerrilla urbanists, known as *Bus-Stop City* have taken to installing modular stools at stops without sufficient seating (Barragan, 2014), while in Haifa, Israel, artists at a local university have installed book-lined bookshelves at several bus shelters to help riders pass the time while waiting for the bus (Kloosterman, 2011).

These projects have each sparked conversations in their respective communities about the utility of public space, the experience of waiting for the bus, and the cost and amount of time it takes for city bureaucracies to address relatively minor deficiencies in the built environment. Frustrated by the top-down, capital-intensive, and time-consuming nature of city projects, these guerilla planning groups informally took matters into their own hands, teaching cities a valuable lesson in how to create quicker, cheaper, and easier projects in the process. City planners may never be able to completely eliminate waiting times at bus stops, but through creative, small-scale, and community-driven improvements, they may be able to improve the bus stop experience to an extent that renders waiting times irrelevant.

WHY ALAMEDA COUNTY?

While currently in its concept phase, the stoplet is likely to eventually make its debut on the streets of California's Alameda County. In 2004, two Alameda County-based transportation advocacy organizations – Transform and Bike East Bay – proposed a program to fund local bicycle and pedestrian infrastructure projects that would make it safer and easier for people to walk and bicycle to and from public transit stops and stations around the Bay Area (Safe Routes to Transit, 2015). In 2007, the Metropolitan Transportation Commission (MTC) officially launched the *Safe Routes to Transit Program* (SR2T) (Bicycles and Pedestrians: Regional Planning, 2015) with funding from Regional Measure 2, a measure approved by Bay Area voters in 2004 that raised tolls on all state-owned Bay Area bridges by one dollar (Regional Measure 2, 2015).

Between 2007 and 2014, the SR2T grant awarded over $20 million dollars to 54 bicycle, pedestrian, and transit projects throughout the region (Safe Routes to Transit Project Profiles, 2015). These grants have included projects such as the Berkeley Bike Station, Balboa Park BART station pedestrian access upgrades, and BART's railcar reconfiguration to better accommodate bicycles. In 2014 - the final round of SR2S funding - the grant was awarded to seven projects around the East Bay, including two projects proposed by the Alameda-Contra Costa Transit District (AC Transit) – the East Bay's predominant transit agency (Safe Routes to Transit Gets Innovative, Awards 7 East Bay Projects, 2015). One of the grants awarded to AC Transit was for a project proposal entitled *Bus Bulb Parklet Design Standards and Guidelines Manual*. For this project, Transform and Bike East Bay - the SR2S grant administrators - allocated $100,000 to AC Transit for a bus bulb parklet (or stoplet) design manual. While this design manual has been funded by the MTC, it has yet to be written. This project is being conducted in partnership with AC Transit to help bring this manual, and the world's first stoplet, to Alameda County.

PROJECT BACKGROUND, OBJECTIVE, AND OVERVIEW

The idea for this project came about in the summer of 2014 during my internship at the San Francisco Municipal Transportation Agency (SFMTA). One Saturday, while doing work at my local neighborhood coffee shop, the coffee shop owner, aware of my internship position, approached me about a concern he had regarding a change in the bus route that stopped in front of his business. The SFMTA was proposing to consolidate the bus stop in front of the coffee shop, and the owner was concerned that he was going to lose a great deal of business in the process. The coffee shop owner and I brainstormed solutions to this problem and determined that if the bus stop could not be maintained, an effective business retention strategy would be to install a parklet in front of the business. But if the bus stop could be preserved, the coffee shop owner wondered, does the city allow for the two street treatments to exist in the same place? While the answer is currently "no," this question has since spurred this project's research.

After presenting the stoplet idea to the SFTMA, an employee who sits on Transform's board informed me that AC Transit had recently received a grant for a similar concept that was still in its nascent stages of implementation. I reached out to the AC Transit grant-writer and we agreed to collaborate on the implementation of this project.

The manual proposed in AC Transit's grant includes six chapters (Safe Routes to Transit Grant, 2013). This project provides the content for three of these chapters: the purpose and need for such a street treatment, a literature review on the benefits and trade-offs of both parklets and bus bulbs, and recommendations on where and how to implement these interventions. Specifically, this project explores the following questions:

1. What are the benefits and limitations of bus bulbs?
2. What are the benefits and limitations of parklets?
3. How does the stoplet improve upon the existing urban environment?
4. What are the compatible and conflicting elements of existing bus stop and parklet design and location guidelines?
5. Where should stoplets be located in Alameda County?

The paper answers these questions in the below sections. The second chapter addresses the first two questions through a comprehensive literature review on bus bulb and parklet benefits and limitations. Chapter three addresses question three by explaining the need and purpose of stoplets, as they benefit transit riders, business customers, and community members in a multitude of ways. Chapter four looks at the research questions posed by this project and the methodologies established to answer these questions. Chapter five addresses question four through a comprehensive set of stoplet design and location guidelines that incorporates research from a variety of existing bus stop and parklet guideline manuals. It also provides visual representations of these guidelines to illustrate how these guidelines might manifest themselves on the street. Chapter six addresses question five through a suitability analysis conducted in ArcGIS that incorporates a variety of spatial data to determine where in Alameda County these street improvements are best suited. And finally, chapter eight addresses some of the challenges that AC Transit might face in implementing stoplets and additional recommendations based on these challenges.

Literature Review

The literature on bus stop and parklet design and location can generally be divided into three overarching categories: safety, security, and user experience. Literature on bus stops also addresses bus stops' effects on bus efficiency, while literature on parklets covers parklets' effects on economic activity. This literature review looks at prior research on bus stop and parklet location and design to determine how the placement and design decisions of both street treatments have either improved or diminished the experience of the user. The conclusions from this review are later incorporated into a set of stoplet design guidelines as well as a geographic suitability analysis to determine the ideal locations for this street treatment in the areas of Alameda County with existing parklet programs. This research is distinct from previous design guidelines and analyses in that it incorporates these guidelines into a single set of recommendations and confines its geographic analysis to Alameda County.

BUS STOPS

There is a vast amount of research available on how to improve bus stop design. This review categorizes the relevant research into four major sections: *safety*, *security*, *perception*, and *efficiency*. While researchers do not dispute the need for existing transit stop improvements, they differ greatly on what these improvements should look like based on the themes of their research.

Safety

Safety is a major issue for transit agencies today. Since New York City Mayor Bill De Blasio first announced his commitment to zero traffic fatalities on the streets of New York by the year 2024 (Vision Zero in New York City: Year Two, 2015), five other US cities have followed suit, laying out similar commitments (Goodyear, 2015). While the vast majority of traffic collisions in the US are between motor vehicles, there are still thousands of pedestrian collisions in the country every year (Traffic Safety Facts, 2014). In 1997, 77,000 pedestrians were injured and 5,300 pedestrians were killed in collisions involving motor vehicles (A Review of Pedestrian Safety Research in the United States and Abroad, 2004). While few of these were at or around bus stops (2%-3%) (A Review of Pedestrian Safety Research in the United States and Abroad, 2004), this percentage is still significant enough for transit agencies to consider when creating street safety guidelines, and for academics to address in their research. In a 1975 report for the Federal Highway Administration on pedestrian accident mitigation strategies, author Wallace Berger's research on bus stop relocation indicates that moving a bus stop from the nearside to the farside of an intersection reduced the percent of crossings from 100 to 0 crossings of the same nature, which he concluded significantly improves pedestrian safety (Urban Pedestrian Accident Countermeasures Experimental Evaluation, 1975). While the relocation did in fact stop pedestrians from crossing in front of the bus, there were neither any collisions nor any pedestrian traffic violations in either the before or after study, rendering the study inconclusive at best. A 2006 study of another bus stop safety feature examined the safety effects of *bus boarders* in London (Accessible Bus Stop Design Guidance, 2006). In the United States, these features are called *bus bulb outs.* As mentioned in this paper's introduction, *bus bulb outs* are defined as sections of the sidewalk that extend from the curb to the edge of the parking lane to make it easier for public buses to pick up and drop off passengers. In their research, the authors collected data at four bus stops before and after bus bulb outs were installed, in addition to analyzing historical collision data at the sites. The purpose of the research was to assess the safety, efficiency, accessibility and economic effects of the street treatment. While researchers did not find a statistically significant change in the number of collisions at the intersections, they did note fewer conflicts between pedestrians and other road users, as well as a significant decrease in passengers who had to step into the street when boarding and alighting the bus (an over 64% decrease at three intersections). They also found significant improvements in travel time efficiency, which is discussed in more detail below (Kay Fitzpatrick, 2001). Finally, in a study that looked at passenger and operator perceptions of bus stop safety features, respondents rated transit curb extensions (or bus bulb outs) as either a good or very good type of safety improvement more than any other feature (see Figures 3 and 4) (Johnson, 2005).

Figure 3: Passenger Safety Ratings by Stop Types

TABLE 24
PASSENGER SAFETY RATINGS BY STOP TYPES

Stop Type	% Agencies Responding				
	Very Good	Good	Fair	Poor	Very Poor
Bus bay/cut outs	48	33	15	3	—
Transit curb extensions	45	50	5	—	—
Stops in the median of a street	—	20	60	13	7
Stops on left side of the bus	—	—	100	—	—

Source: Survey results.
Note: Percentages do not add to 100% due to rounding.

(Better On-Street Bus Stops, 2015)

Figure 4: Bus Operator Safety Ratings by Stop Types

TABLE 26
BUS OPERATOR SAFETY RATINGS BY STOP TYPES

Stop Type	% Agencies Responding				
	Very Good	Good	Fair	Poor	Very Poor
Bus bay/cut outs	33	39	24	3	—
Transit curb extensions	45	32	18	5	—
Stops in the median of a street	27	33	33	—	7
Stops on left side of the bus	—	100	—	—	—

Source: Survey results.
Note: Percentages do not add to 100% due to rounding.

(Better On-Street Bus Stops, 2015)

Security

Several studies on bus stop design improvements focus on the goal of *security*, or safety from crime for the transit rider. One such paper, written in 1986 by academics Levine, Wachs, and Shirazi, looked at bus stop crimes in Los Angeles that occurred within the west-central neighborhoods of the city (Levine, Wachs, & Shirazi, 1986). The researchers analyzed the crime data made available to them by the Los Angeles Police Department and determined which bus stops saw the most crime. They later went out to the three most dangerous bus stops and made observations about the built environment surrounding these stops and the habits of individuals who interacted with the space at various times throughout the day. Concurrently, they surveyed households in the west-central part of the city, asking them personal questions about bus and bus stop-related crime. Their interviews found that 54% of bus crimes occur off of the bus, and that life-threatening crimes usually occur between the hours of 10:00pm-12:00am. They also noted that off-bus crime seemed to be less common among large crowds of people, indicating that even at late hours, bus stop crimes could be prevented through the mere presence of others.

In a later paper entitled *Hot Spots of Bus Stop Crime,* Loukaitou-Sideris looked at the ten most dangerous bus stops in Los Angeles, based on analyzed crime data from 1994 and 1995 (Loukaitou-sideris, 2007). After identifying these ten intersections through quantitative analysis, the author analyzed the stops by observing transit riders' behavioral patterns, collecting inventory of adjacent land uses, interviewing local security officers and merchants, and surveying a random sample of transit passengers. The author's initial analysis of crime data found that bus stop crime accounts for 67% of total transit crime in Los Angeles. She also found that most crimes occur during the late afternoon, while the most serious crimes occurred between 10:00pm-12:00am (reflective of the Levine Wachs, and Shirazi's study). The results of this observational analysis found that the ten bus stops had similar characteristics, which likely contributed to their high crime statistics. These characteristics included "bad neighbors" (liquor stores, check cashing businesses, SRO's, vacant buildings, and surface parking lots), desolation and lack of surveillance, bus stop crowding, broken windows (neglected adjacent buildings), and easy escape routes. In their interviews with passengers, the researchers found that a variety of amenities could be used to improve perceptions of rider security at stops, including better lighting (46%), bus shelters (33%), better bus stop locations (26%), cleanliness (26%), public phones (21%), and better visibility (19%).

In a more quantitative paper, Loukaitou-Sideris and several colleagues examine how particular bus stop and built environment attributes contribute to the real or perceived safety of transit riders in Los Angeles (Anastasia Loukaitou-Sideris R. L., 2001). The authors used a random sample of 60 bus stops in downtown Los Angeles and compared the environmental attributes of each stop with crime rates and types in the immediate vicinity. The research concludes that bus stop crime increased in instances where there was a significant amount of litter and graffiti, where "undesirable establishments" were present (defined as liquor stores and check cashing businesses), where alleyways were close by, where large closed-front commercial buildings existed, and when bus stops sat behind on-street parking. Conversely, the authors found lower crime rates at bus stops with good lighting, good visibility, and the presence of bus shelters. These correlations were determined to be significant through a regression analysis, which enabled the authors to weed out bus stop characteristics that were less strongly correlated to crime.

The aforementioned research on bus stop crime will inform both the design guidelines and suitability analysis of stoplets in the cities of Oakland and Berkeley. While several bus stop design guidelines incorporate safety considerations into their recommendations, these guidelines tend to focus on traffic safety versus safety from crime, and thus fail to consider aspects of the surrounding built environment (Guidelines for the Location and Design of Bus Stops, 1996) (Accessible Bus Stop Design Guidance, 2006) (Stops, Spacing, Location, and Design, 2015). In research that analyzes the suitability of bus stop locations, the built environment is similarly neglected (Vanapalli, 2008) (Hazaymeh, 2009) (Enosko, 2012). In a departure from previous research, this paper incorporates the conditions of the built environment in both its guidelines and suitability analysis.

Perception

The perception of the passenger is arguably the single most important factor in determining what qualifies as "good" bus stop design. There are several papers that have researched user perceptions of bus stop quality as they relate to comfort, convenience, wait time, and safety. The following articles are particularly relevant to this research project, as they look specifically at bus stop amenities and their individual effects on rider perceptions.

The first such paper is Todd Litman's *Valuing Transit Service Quality Improvements* (Litman, 2008). This paper examines the value that transit riders place on the quality of transit service by looking at how various characteristics of a transit trip affect riders' travel time valuation, in an effort to point transit planners toward cost-effective tools to improve transit service and subsequently increase ridership. Litman's research is a meta-analysis of previous literature on the value transit riders assign to their travel time. Through his research, Litman looks at a variety of improvements that could be made to bus service and details the amount of money riders would be willing to spend on these changes to their commute. These improvements include faster travel, reduced crowding, more comfortable vehicles, better waiting conditions, improved walking conditions, improved coverage area, and real-time arrival information. He concludes that the overall cost of a transit trip (when accounting for travel-time valuation) is reduced significantly when comfort and convenience improvements are made. He asserts that current transit service quality analysis methods rely heavily on quantitative factors and tend to undervalue qualitative factors, which are more difficult to measure, but play an equally important role in rider perceptions of public transit.

A second paper on user perceptions of travel time generally supports Litman's meta-analysis on the subject. In a yet-to-be-published paper by Fan, Guthrie, and Levinson from the University of Minnesota, the authors survey 822 passengers at 36 bus and train stops and stations around Minneapolis in an effort to compare perceptions and reality of rider wait times as they relate to transit stop amenities (Levinson, 2015). The most notable conclusions from their analysis are threefold: for wait times under 10 minutes, the presence of a shelter significantly reduces wait time perceptions for all users; for wait times over 10 minutes, the presence of a bus schedule significantly reduces wait time perceptions for all users; and for wait times of all lengths, a feeling of vulnerability increases wait time perceptions for female users.

A third paper on the effects of the waiting experience on rider perceptions is Brian Taylor and Hiroyuki Iseki's 2010 paper, *Style Versus Service?* (Taylor, 2008). This paper examines which attributes of transit stops and stations are the most important to the transit rider and with which attributes riders are currently satisfied. Through a survey of 749 riders at 12 strategically selected train and bus stations and stops throughout the county of Los Angeles, the researchers make several determinations. In somewhat of a departure from the previous two studies, the researchers find that ease of navigation, personal safety, and service reliability are the overall most important factors in riders' satisfaction with a stop or station. Riders tend not to value the facilities' physical characteristics as much by comparison. One question that this paper leaves unanswered is what the term "personal safety" means to survey respondents. While the paper concludes that bus stop amenities are less important to transit riders than the aforementioned factors, related research conducted by Loukaitou-Sideris et al concludes that many of these amenities are key to establishing safer conditions at bus stops (Anastasia Loukaitou-Sideris R. L., 2001).

A more in-depth analysis of user perceptions of transit waiting experiences was conducted a couple of years later in a paper entitled *Hate to Wait,* co-authored by the same researchers (Allison Yoh, 2011). In this paper, the authors expand on their analysis of the waiting experience of transit riders by measuring the relative importance of stop and station amenities to riders at different times throughout their wait, in order to determine if certain stop attributes become more or less important over the length of their waiting time. To measure rider satisfaction, the researchers conducted over 2,000 surveys of transit riders at 36 transit stops and stations throughout California over a three-year period. They conclude, as they did in their previous research, that reliability and safety are the most important issues to address when seeking to improve rider satisfaction. But in a nod to Litman and Fan, Guthrie and Levinson's research, they also conclude that bus stop amenities all become significantly more important to riders as their waits get longer. Characteristics whose importance they determine to increase over time include signage, schedule and route information, shelter, and seating.

Taken together, these articles expose the nuance and complexity of user perceptions of the transit waiting experience. While the research is inconclusive about what the most important aspect of the waiting experience is to the transit rider, it is clear that frequency and reliability, security, and amenities all play an important role. While improving upon the design and location of transit stops does not often lead to improvements in transit frequency or reliability, it can affect user perceptions of wait time and security at each stop. The lessons from the aforementioned articles on the types of amenities that improve these perceptions will ultimately be incorporated into this research paper's design guidelines and suitability analysis.

Efficiency

In addition to improving user security and travel time perceptions, good bus stop design and location can also directly contribute to the efficiency of a transit route. Kay Fitzpatrick, Kevin Hall, Stephen Farnsworth, and Melissa Finley's paper, *Evaluation of Bus Bulbs,* details such improvements (Kay Fitzpatrick, 2001). The authors look at four North American cities on the west coast - San Francisco, Portland, Seattle, and Vancouver - and evaluate each city's goals in implementing bus bulbs and the results of the installation to get a better understanding of bus bulb utility. The goals of the research were to determine bus bulbs' effect on public transit, private vehicle, and pedestrian efficiency, to determine best practices for when and where to implement bus bulbs, and to identify a similar set of best practices based on the results of a computer simulation. The methodologies used in the study were four-fold: interviews with transit agency staff, a curbside before-and-after study of pedestrian activity, a roadway before-and-after study of transit and vehicular activity, and a computer simulation of the effects of bus bulbs on bus and vehicular traffic.

Results from Fitzpatrick, Hall, Farnsworth, and Finley's empirical research found an 11% increase in pedestrian flow during peak-hours, a 7% increase in bus speed, and a 17% and 46% increase in private vehicle speed (northbound and southbound, respectively) along the observed corridor. The computer simulation had very different results, finding that installing bus bulbs would have minimal effect on bus and vehicle speeds along the corridor. While it is possible for a computer simulation to compliment other research methods, it should be approached with far less credence than empirical research.

A second paper, *Identifying Locations for Bus Nub Installation on Urban Roadways* (J Daniel, 2003), seeks to follow up on the research of Fitzpatrick et al with an additional analysis on bus bulbs' effects on vehicular traffic. The goal of the paper is to quantify trade-offs between transit service improvements and roadway congestion when considering the installation of bus bulbs at an intersection. The paper seeks to quantify these trade-offs through a mix of formulae found in the Highway Capacity Manual and Transit Capacity and Quality of Service Manual as well as a computer simulation model known as CORSIM. The analysis found that installing a bus bulb would result time savings of between 15 and 30 seconds per bus stop. Unfortunately, due to several holes in the research, this study's findings are unreliable. To start, the only references cited in the literature review are *Evaluation of Bus Bulbs* and its parent report, *Guidelines for the Location and Design of Bus Stops*, which both openly acknowledge the issues inherent in using computer simulations to conduct such research (Kay Fitzpatrick, 2001) (Guidelines for the Location and Design of Bus Stops, 1996). Despite this, the authors of this report rely exclusively on theoretical research and neglect to conduct any simultaneous empirical research to help support their findings. Additionally, the researchers acknowledge the many limitations of the formulae and simulation used in their analysis, including the Highway Capacity Manual formula's inability to distinguish between nearside and farside stops, and the CORSIM simulation's inability to analyze bus travel times in the presence of queues.

Research on the effect of bus location and design on transit efficiency will help to inform the size and placement of stoplets around the Berkeley/Oakland area. While the aforementioned articles look at bus bulbs' general effects on efficiency, additional research details the ideal dimensions, spacing, and locations of bus bulbs, which will all be thoroughly examined and incorporated into the design recommendations of this report.

PARKLETS

Parklets are small public spaces that generally take up two to three on-street parking spaces. They began as a demonstration to call into question the existing use of public street space (Frequently Asked Questions, 2012). Whereas cities have traditionally designated the space between the sidewalk and travel lane for the free or cheap storage of private goods, parklet advocates argued that this space could be used for a variety of uses that would much better serve the public. These uses include space for people to sit and relax, more space for people to walk along the sidewalk, attractive space outside of local businesses to attract new customers, and space for neighborhood residents to gather, thus creating a stronger sense of community for local residents (Parklets: converting street parking spaces to mini plazas, 2015). This section specifically addresses the research surrounding the importance of public space and the specific benefits that parklets provide to the urban environment, including safety, security, and economic vitality.

Public Space

Public space provides a multitude of benefits for city residents. These benefits can be broken down into three general categories: (1) social benefits, (2) economic benefits, and (3) safety benefits. Social benefits can have psychological, political, and community-strengthening implications. A 2004 report from Greenspace Scotland consolidated 44 research papers that found public space to have positive effects on everything from residents' mental health, to a neighborhood's level of community involvement, to a general sense of social equity (Greenspace Scotland Research Report, 2008). Other studies have shown positive correlations between aspects of public space (human interaction, exposure to greenery) and mental health (Wilson, 1984) (Kellert, 1995). Public spaces also offer otherwise rare opportunities for people to interact with people of different cultures, ethnicities, and socioeconomic backgrounds (Shaftoe, 2008) and often provide democratic societies with a place to gather signatures, make public speeches, and express political dissent (Wood, 1991).

Public spaces also reap economic benefits. These can come in the form of direct benefits, by providing a space for vendors to sell their wares, or they can come indirectly, in the form of increased tourism, higher property values, and a boost to business in the surrounding areas (Shaftoe, 2008). Investments in public space can also have a significant effect on a local economy. In Melbourne, Australia and Glasgow, Scotland, after major investments in their public space infrastructure, both cities underwent a drastic economic transformation (Shaftoe, 2008).

Finally, public spaces can help to enhance public safety if planned and designed in such a way to attract human activity. In their research, Felson and Clarke indicate that criminal activity decreases in areas where potential criminals are aware that law-abiding citizens are present (Clarke, 1998). This supports Jane Jacobs' famous *eyes on the street* theory, in which she asserts that by planning a city in such a way that orients residents' and visitors' eyes toward public spaces, safety will be improved for everyone (Jacobs, 1961).

Security

With a hefty $25,000 price tag (Anastasia Loukaitou-Sideris M. B., 2012), parklets are not affordable for every business. As a result of both their high cost and cumbersome bureaucratic process, parklets tend to be pursued by wealthier business owners in neighborhoods where the parklet has a high probability of success. As a result, parklets are almost always built in areas with good visibility, frequent use, and a sense of ownership by both the adjacent business and the local community. Such areas also tend to be bereft of criminal activity (Lesley Bain, 2012). While there is no existing research specifically on parklets' effect on crime, there is a great deal of research on the effect of eyes on the street on crime, as previously mentioned. Research shows that more eyes on the street leads to less criminal activity (McCann, 2013). The research that does exist on parklets' effect on human behavior points to significant increases in pedestrian activity which, based on aforementioned research, leads to lower crime rates. For example, in one study on the effects of San Francisco's parklet program, researchers showed that pedestrian traffic increased 37% on weekday evenings (Pratt, Divisadero Trial Parklet Impact Report, 2010), the same time of day that Levine, Wachs, and Shirazi concluded to be the most dangerous when waiting at a bus stop (Levine, Wachs, & Shirazi, 1986). In a second study out of San Francisco, researchers found a 44% increase in foot traffic after the installation of a parklet, with foot traffic increasing over 100% on evening weekends (Pratt, Parklet Impact Study, 2011).

Safety

Parklets' effect on pedestrian traffic can also affect a given area's pedestrian injury rate. In a 2003 study, public health consultant Peter Jacobsen found that a 100% increase in pedestrian traffic led to a 66% reduction in the pedestrian injury rate of the same area (Jacobsen, 2003). Pedestrian perceptions reflect this reality. In a customer satisfaction survey conducted by the San Francisco Planning Department, parklets' role in protecting pedestrians from passing vehicles was the highest rated benefit among all survey takers (Ocubillo, 2014).

While there has been no direct research on parklets' effect on vehicle volumes or speeds, there has been research on curb extensions' effects on both. Curb extensions are similar to bus bulb outs in that they extend the sidewalk into the street to the edge of the parking lane, but they differ in that they are installed exclusively to improve the pedestrian experience and not to improve the efficiency of the transit system. Curb extensions are similar to parklets in that they can have a "calming effect" on vehicular traffic along the street. While the research on curb extensions' effect on vehicular speeds is inconclusive (Cynecki, 2001), curb extensions do tend to have a significant effect on the volume of traffic that travels along a street. In a study on curb extensions' effects on pedestrian safety, researcher Randal Johnson found that after curb extensions were installed at an intersection in Albany, Oregon, traffic volumes decreased by over 33% (Johnson, 2005).

Economics

Parklets create unique, attractive, and pedestrian-friendly streets that help distinguish a local shopping experience from that of a mall experience characterized by chain stores and parking lots (Lesley Bain, 2012). In the same way that public spaces generate economic benefits for entire cities, parklets generate pedestrian activity along commercial corridors, leading to a more localized type of economic development (Lesley Bain, 2012). By creating a more pedestrian-friendly environment, parklets engender walking, human interaction, and a proclivity to stop at more stores more frequently (The Economic Benefits of Sustainable Streets, 2011). By providing seating, they also attract the attention of passers-by and give customers a reason to linger around shopping areas longer (Pratt, Parklet Impact Study, 2011). While research has yet to look into the direct economic impact of parklets, the indirect impact and anecdotal evidence is significant enough for businesses to perceive a positive economic impact, which has resulted in a recent explosion in parklet permit applications in San Francisco, despite the requirement that businesses cover permitting, design, construction, and maintenance costs (Pratt, Parklet Impact Study, 2011), which can amount to upwards of $80,000 (Curry, 2014).

The most detailed analysis of existing parklet programs throughout the country can be found in Madeleine Brozen and Anastasia Loukaitou-Sideris' research on the implementation and design of parklets (Anastasia Loukaitou-Sideris M. B., 2012). Their research is based on case studies from seven North American cities, interviewing local public officials, community partners, business owners, and parklet designers to determine best design and implementation practices. Throughout these interviews, they discover many trends as well as a few differences. Among the seven parklet programs incorporated into their research, all seven started off as pilot projects. All seven programs led to more tactical urbanism projects down the road, and all had similar goals, including: 1) to provide inviting public spaces for people, 2) to foster local economic development, and 3) to increase livability by providing benefits to residents, businesses, community groups, and visitors. The major difference between case studies was that some cities stressed the public access of the spaces while others (Long Beach and Montreal) left that to the discretion of the business maintaining the space.

Design and Location Considerations

Brozen and Loukaitou-Sideris' research is extensive in the amount of data they gathered from each city on design and policy guidelines and best practices. There is a wealth of information in the booklet about each city's standards in terms of size, drainage, visibility, load-bearing, and cost of each parklet, and a handful of recommendations based on guidelines and interviews from each city. These recommendations include: 1) identifying residual space in priority areas, 2) encouraging variety in parklet design, 3) tailoring design to community needs, 4) providing urban design guidelines, 5) streamlining the permitting process, 6) designating a lead staff person and public agency, and 7) streamlining maintenance requirements.

A second paper on the subject takes a more local approach, but one that has the potential to be equally instructive for practitioners seeking to facilitate the installation of a parklet in their jurisdiction. Gene Stroman's *Opportunity Mapping San Francisco Parklets and Plazas* (Stroman, 2014) looks at parklet opportunities in San Francisco through a comprehensive geospatial analysis, so as to provide other cities with a thoughtful and well-researched strategy for prioritizing parklet projects of their own. Stroman's analysis incorporates several geospatial data, including public open spaces and their respective "walkshed," street slope, and proximity to neighborhood commercial districts. The ultimate outcome of the GIS analysis is a network of streets that are logistically suited for parklets, which he refers to as the *Opportunity Street Segment Index*.

A third research paper - an urban planning graduate school thesis - looks into the concept of the parklet and its viability and ideal geographic placement in the city of Somerville, Massachusetts (Smead, 2013). The premise of the paper is that Somerville is a "park-poor" community with ambitious plans for creating new public open space over the coming years, and thus would greatly benefit from the low-cost, easily implementable urban street treatment. The author's methods of analysis are two-fold: 1) interviews with local stakeholders and parklet program administrators from across the country to gauge interest, concerns, and a set of best practices for the project's implementation, and 2) a GIS analysis of the city, incorporating factors such as existing pedestrian activity, existing amounts of open space, and environmental justice demographics to determine the areas of the city most deserving of the street treatment. While her general approach to the topic is sound, the author fails to explain how and why she incorporated particular data into her own final index. Despite mixed reactions from the community about the effect of parklets on the community, her research concludes that parklets would make Somerville's commercial corridors more inviting to customers, pedestrians, and bicyclists, and her suitability analysis identifies three particular neighborhoods that would benefit from their installation.

The aforementioned articles will be helpful to identify design characteristics that will contribute to a successful stoplet program throughout Alameda County. Through a thorough analysis of both Brozen and Loukaitou-Sideris' research and the parklet design guidelines of various cities and organizations (Smead, 2013) (San Francisco Parklet Manual, 2015) (Philadelphia Parklet Program Guidelines), this report will determine overlapping design constraints to incorporate into its set of recommendations. And by borrowing from the GIS analysis of Stroman and Smead, the report will conduct a suitability analysis that incorporates both the best practices from their research and considerations tailored to the idiosyncrasies of the Berkeley-Oakland communities.

Questions and Methods

This chapter explains the research questions and methods used in this study. Two separate questions framed this project's research, resulting in two distinct research analyses – one qualitative and one quantitative. The question that framed the paper's qualitative analysis was, "What lessons can be learned from parklet and bus stop design that we can apply to the design and construction of stoplets?" This question was answered through a meta-analysis of the existing guidelines on both bus stop and parklet design, ultimately resulting in a set of guidelines that are applicable to future stoplet design and construction. The question that prompted this paper's quantitative analysis was, "What are the best locations in Oakland and Berkeley for this new design intervention?" This question was answered through an ArcGIS suitability analysis, which ultimately resulted in a *Stoplet Index* map that prioritizes areas in Oakland and Berkeley where stoplets should be prioritized.

META-ANALYSIS

This project's meta-analysis is essentially a review, re-organization, and consolidation of every large-scale bus stop and parklet design guideline manual in existence today, with the exception of city-specific guidelines that are not relevant to this project's geographic area. This component of the project looks at all of these guidelines in an effort to determine collective best practices, and to identify areas of compatibility and conflict within bus bulb and parklet literature and between the two. The ultimate outcome of this meta-analysis is conveyed in the recommendations chapter at the end of this paper, which lays out a set of guidelines for the design and implementation of stoplets based on the literature reviewed and the compliments and contradictions uncovered through the research.

Determination of Resources

Resources for this meta-analysis were determined based on explicit online and library searches for design guidelines, as well as additional recommendations from this project's client representative. All of the resources cited in the meta-analysis are design guidelines with either a national scope or a scope that is geographically relevant to this project, with the exception of those guidelines from the Southeastern

Pennsylvania Transportation Authority (SEPTA) and Transport for London (TfL). These two guidelines were included in the meta-analysis based on their substance, which was determined to be beneficial to the overall quality of analysis. The complete list of agencies and organizations whose guidelines were reviewed for this meta-analysis is listed below.

Table 1: List of Guideline Resources

Bus Stop Design Guidelines	Parklet Design Guidelines
Alameda-Contra Costa Transit District (AC Transit)	City of Oakland
American Association of State Highway and Transportation Officials (AASHTO)	National Association of City Transportation Officials (NACTO)
American Public Transportation Association (APTA)	San Francisco Planning Department
Better Streets San Francisco (BSSF)	University of California, Los Angeles, Luskin School of Public Affairs (UCLA Luskin)
Federal Transit Administration (FTA)	
National Association of City Transportation Officials (NACTO)	
Southeastern Pennsylvania Transportation Authority (SEPTA)	
Transport for London (TfL)	
Transit Cooperative Research Program (TCRP)	

Research Structure

After reviewing the literature on bus stop and parklet guidelines, I then categorized findings into 13 categories that I deemed to be the most relevant to answer my first research question. These categories include:

Table 2: List of Guideline Categories

Guideline Categories	
1	Accessibility
2	Dimensions
3	Drainage
4	Landscaping
5	Lighting
6	Materials
7	Safety features
8	Seating
9	Shelter
10	Signage
11	Street conditions
12	System information
13	Additional amenities

These categories and the associated information from each set of guidelines were compiled into a single spreadsheet that helped me to detect when recommendations complemented or contradicted one another. The findings from this meta-analysis are detailed in Chapter Four, and inform this project's final recommendations in Chapter Six.

Research Limitations

While this meta-analysis resulted in important insights into how to create a street treatment that incorporates best practices from bus stop and parklet design, there were a couple of limitations to this methodology. The first had to do with the way the research was categorized. In trying to compare and contrast various aspects of design guidelines, it is likely that recommendations were left out that didn't fit neatly into one of these 13 categories. Also, by trying to condense hundreds of pages of guidelines into several pages of findings, additional information was likely omitted during this process. Finally, while contradictions between the various guidelines are directly addressed in Chapter Six's *Challenges* section, it remains unclear whether these challenges are irreconcilable or if they can be overcome during the stoplet implementation process. This question likely won't be resolved until a stoplet is actually on the ground and these theories can be tested in real time.

SUITABILITY ANALYSIS

In cities with existing parklet programs, it is primarily small business owners who influence where parklets will be located. But public agencies and non-profits can also play a role in where parklets are implemented by creating criteria to prioritize certain locations for parklet installation, as well as by providing encouragement, technical support, or funding to businesses in those areas (Anastasia Loukaitou-Sideris M. B., 2012). For stoplets, it is particularly important for the city to be involved in developing these standards in order to maximize both system efficiency and equitable distribution of resources. In developing an ArcGIS stoplet suitability analysis, this paper seeks to accomplish both of these goals. By quantitatively analyzing Alameda County's land uses, demographics, and transportation network, this research can help the county's transit agency determine its priorities and focus its efforts on bus stops in most need of improvement. Because there are currently only Alameda County parklet programs in the cities of Oakland and Berkeley, this paper limits its stoplet suitability analysis to these two municipalities, which it deems most likely to pilot such a program.

Determination of Resources

There are an endless number of factors to consider when determining what to incorporate into a suitability analysis. The factors incorporated into this analysis can be broken down into two overarching categories: 1) requirements, or the necessary conditions for implementation, and 2) recommendations, or the desired conditions for implementation. Initially, the list of factors considered was exhaustive. Necessary conditions included bus stop locations, street grade, street speed limit, and adjacent land uses at each bus stop. Desired conditions included existing park locations, existing parklet locations, daily traffic volumes, sidewalk width, bus models by route, average number of boardings at each stop, and existing amenities at each stop. While there were legitimate reasons behind all of these factors, some of the data was difficult to acquire and other data was deemed to be superfluous to the research.

Ultimately, only six factors were incorporated into this paper's suitability analysis: 1) bus stop locations, 2) retail business locations, 3) street grades, 4) street speed limits, 5) proximity and size of existing public parks, and 6) median household incomes. The initial four factors were incorporated into the analysis because they are necessary preconditions for stoplet implementation based on previous bus stop and parklet design guideline research. The final two factors were incorporated to ensure a more equitable distribution of resources.

Research Structure

In conducting the stoplet suitability analysis, I analyzed the aforementioned data on a census tract level so as to suggest specific areas that AC Transit should prioritize for stoplet implementation. The index's three data inputs were 1) median household income per tract, 2) percent public park space per tract, and 3) number of potential stoplet locations per tract. To calculate the number of potential stoplet locations per tract, I created a set of parameters through which bus stop locations were filtered, leaving only "suitable" bus stop locations on the map. In order to be considered a potential stoplet location, bus stops had to be within 100 feet of a *suitable* retail business (see appendix), on a street with a speed limit of 25 miles per hour or less, and on a street with a slope of 5% or less. Once these filters were established, I was able to determine how many potential stoplet locations existed in each census tract.

Next, I determined the percent of dedicated public park space per census tract. To do this, I calculated the square footage of total park space in each tract and divided that number by the total square footage of the tract itself. This gave a second input for the index. Finally, I looked at median household income per census tract. This data is made readily available on the US Census website, so I did not have to alter it in order to conform it to my index.

After producing the maps to illustrate these three inputs, I incorporated the inputs into a single index to best determine where stoplets should be prioritized in Oakland and Berkeley. The process of creating this index and the findings that came out of it are detailed in Chapter Five of this paper.

Research Limitations

While the factors I incorporated into my index are important for a city or transit agency to consider when launching a local stoplet program, there are an infinite number of approaches to take and datasets to incorporate into such an analysis. Any agency, organization, or individual looking to create their own stoplet suitability index should be mindful of the quality of the data to which they have access and the relevance of the data to the analysis they intend to conduct. Despite working with a relatively small set of data and taking a rather straightforward approach, this analysis faces several research limitations.

The greatest limitation of this research is the fact that much of the data I chose to incorporate into my analysis is constantly changing. The average life span of a retail business is about eight and half years (Kelly, 2005). The most recent retail business data I was able to obtain is from 2010 data. Therefore, it is possible that over half of the businesses I incorporated into my analysis are now closed. Similarly, bus routes change, new bus stops are added to the existing network, and other bus stops are consolidated with some frequency. AC Transit's most recent set of service changes was less than two years ago (Major Service Changes Effective December 15, 2013, 2013). Based on these issues alone, it is unlikely that the data incorporated into this analysis is perfectly accurate.

Another limitation of this research was my decision to look at all retail businesses within 100 feet of a bus stop. I chose a 100-foot buffer because it would account for slight inaccuracies in the geolocation data of the businesses. But in doing so, it is possible that it paired retail businesses with bus stops that were across the street or otherwise far enough away that it would be unlikely for the business to sponsor a stoplet. A second limitation to my retail business data is that it incorporates all iterations of retail, including liquor stores, car dealerships, and other business types that may not be effective stoplet implementation partners. While there have been successful models of parklets in locations other than outside of cafes and restaurants, it is unlikely that a liquor store or car dealership would sponsor a stoplet and just as unlikely that a city would approve such a sponsorship.

A final limitation of my research is the accuracy of my street slope data. Despite reaching out to over five agencies and organizations around Alameda County, I was unable to procure street slope data for any part of Alameda County. Thus, I created my own using USGS's digital elevation model (DEM) data, which I later joined to an Alameda County street shapefile. Because this data was derived from 1/3 arc-second (10-meter) DEM data, it only has a resolution of ten meters, so some of the street's slopes may not perfectly reflect the slopes of Berkeley and Oakland's streets.

Meta-Analysis

This section consolidates the most ubiquitous, thorough, and relevant guidelines on bus stop and parklet design. Design guidelines are divided into 13 general categories and individual recommendations from both bus stop and parklet guidelines are detailed in each section. Particular attention is paid to recommendations that can be found in several different guidelines, recommendations that are found in both bus stop *and* parklet guidelines, and recommendations that contradict each other.

ACCESSIBILITY

Bus stop and parklet design guidelines on accessibility are particularly strict, as they must conform to Americans with Disabilities Act (ADA) requirements, a far-reaching federal law enacted in 1990 that affects the design of all public facilities in the United States, with a specific section dedicated to the accessibility of public transportation stops and stations (ADA Standards for Transportation Facilities). Almost all bus stop and parklet guidelines include recommendations for ADA compliance.

In terms of bus stop guidelines, by far the most pervasive requirement is to provide a five-foot (measured parallel to the curb) by eight-foot (measured perpendicular to the curb) wheelchair landing pad that is free from any obstructions (Guidelines for the Location and Design of Bus Stops, 1996) (Designing with Transit: Making Transit Integral to East Bay Communities, 2004) (Transit Stops, 2015) (SEPTA Bus Stop Design Guidelines, 2012). AC Transit calls for two of these boarding areas – one just behind the stop signpost, and one exactly 16 feet behind the signpost to accommodate the rear door (Designing with Transit: Making Transit Integral to East Bay Communities, 2004). San Francisco's Better Streets Plan recommends that the loading pad be accessible from the transit shelter and that a 30-inch by 48-inch clear space be provided underneath the transit shelter to accommodate a wheelchair (Transit Stops, 2015). Several agencies also call for an obstruction-free path of travel to the bus stop itself. Recommendations for this path range from three (Designing with Transit: Making Transit Integral to East Bay Communities, 2004) to four feet (SEPTA Bus Stop Design Guidelines, 2012).

Bus stop guidelines from federal organizations and agencies are far less detailed in their recommendations with the exception of the Transit Cooperative Research Program (TCRP). TCRP calls for several additional provisions, including stable, firm, and slip resistant surfaces, ramps for drops no greater than 0.5 inches or steeper than 1:20, and a ban on protrusions higher than 27 inches and lower than 80 inches to accommodate riders with impaired vision. APTA guidelines also address accommodations for riders with vision impairment, stressing the need for visual guides and signage that is prominent and includes information written in braille.

Parklet guidelines on accessibility are similar to those of their bus stop counterparts. Among the parklet guidelines, the San Francisco Planning Department's (SF Planning) are by far the most comprehensive. SF Planning's manual calls for a four-foot accessible route to the parklet, which can be narrowed to three feet wide while on the parklet (San Francisco Parklet Manual, 2015). The manual also requires both a wheelchair turning area and a wheelchair resting area, which must accommodate 360-degree wheelchair turns and be 30 inches by 48 inches, respectively, with only a 24-inch overlap permitted between the two. Finally, parklet seating must accommodate wheelchair users and the parklet grade must not exceed 1:48 (2%) in either direction at the accessible sections of the parklet. In contrast to SF Planning's comprehensive manual, the City of Oakland's manual merely notes that all parklets must comply with the Americans with Disabilities Act Accessibility Guidelines (Parklet Program Pilot Extension, 2014).

Table 3: Bus Stop Accessibility Guidelines

AC Transit	APTA	Better Streets San Francisco	NACTO	Transport for London	SEPTA	TCRP
>8' x 5' paved space (at least eight feet deep from the curb and five feet along the curb) >3' wide minimum path of travel clear of obstructions to and from boarding area 2 boarding areas: one at the front of the bus stop (just behind the bus pole), the other 16 feet back from the pole >54-60 in clear space between curb and base of the bus shelter/bench (reflects 18-24 in required for bus stop pole placement and >36 in between bus stop pole and shelter/bench required by the ADA)	include curb cuts, ramps, visual guides, signage (visual and Braille) and railing where needed place ADA-compliant curb ramps at each corner of an intersection	clear 5'x8' loading area at front of boarding zone (perpendicular to curb), with <2% cross-slope loading area should be accessible from transit shelter and adjacent to sidewalk if bus zone is for >1 bus, loading zone should be provided for each vehicle 30" x 48" clear space within transit shelter (accessible from sidewalk and loading area) where boarding platforms are not level with sidewalk, an accessible ramp must be provided from sidewalk to platform	ADA standards are required, including provision of landing pads and curb heights that allow for buses to load passengers in wheelchairs	on the sidewalk where the stop is located, an area must be kept clear of all obstructions the length of the clear area is based on the width of the bus doors the width of the clear area is based on the space needed for a wheelchair to maneuver a wheelchair should be able to complete a 360° turn in a space of 1500mm x 1500mm leave at least 2.7m between the curb edge and the rear of the shelter for wheelchair users to maneuver	Loading pad must be five feet long (parallel to the curb) and eight foot deep pedestrian path must be four feet wide or wider waiting areas are separate from the loading pad	if protrusions exist and they are higher than 27 inches or lower than 80 inches, a person with a vision impairment may not be able to detect an obstacle an obstacle anywhere along the path may make it inaccessible for some transit users with disabilities surfaces must be stable, firm, and slip-resistant any drop greater than 1/2 inch or surface grade steeper than 1:20 requires a ramp waiting pads should accommodate a 5-foot by 8-foot wheelchair landing pad that is free of all street furniture and overhangs

Table 4: Parklet Accessibility Guidelines

City of Oakland	NACTO	SF Planning Department	UCLA Luskin
must meet requirements per the Americans with Disabilities Act Accessibility Guidelines (ADAAG)	should have flush transition at sidewalk and curb to permit easy access and avoid tripping hazards	accessible path must connect sidewalk to Parklet Entry, Deck Surface, Wheelchair Turning Space and Wheelchair Resting Space accessible path must be >48 inches wide on the sidewalk and not pass over tree wells; once on platform, must be >36 inches wide cross slope cannot exceed 1:48 (2%) running slope may not exceed 1:20 (5%) allow for wheelchair users to make a 360 degree turn at clear area within parklet if fixed seating exists, should be configured to accommodate companion seating for a wheelchair; wheelchair space should permit shoulder-to-shoulder alignment adjacent to one side of the fixed seat	dependent on city

DIMENSIONS

Bus bulbs and parklets are perhaps more similar in their dimensions than any other characteristic. This section addresses the dimensions of bus bulbs specifically (rather than bus stops in general) because of their comparable size to parklets. Almost all bus stop guidelines address bus bulb dimensions. Most recommend a width of at least 6 feet (Accessible Bus Stop Design Guidance, 2006), or the equivalent width of a parallel parking lane (Urban Street Design Guide: Bus Bulbs, 2015). AC Transit declines to recommend a specific bus bulb width, explaining that travel lane width, the presence of bike lanes, and the existing width of the sidewalk should all factor into the decision at each individual bus stop (Designing with Transit: Making Transit Integral to East Bay Communities, 2004).

In contrast, length recommendations differ greatly among agencies. AC Transit calls for bus bulb lengths of at least 60 feet regardless of the stop (Designing with Transit: Making Transit Integral to East Bay

Communities, 2004), while other guidelines differ depending on the length of the buses that travel along the route and the number of buses that are anticipated to stop simultaneously (Transit Stops, 2015) (Designing with Transit: Making Transit Integral to East Bay Communities, 2004) (Guidelines for the Location and Design of Bus Stops, 1996). Still other guidelines base their recommendation on the frequency of the route, calling for a certain length at high-frequency stops, and a shorter length at low-frequency stops (Transit Stops, 2015).

Parklet width and length guidelines generally fall within the confines of bus bulb dimensions. Specific lengths and widths are not prescribed in all guidelines, but the City of Oakland calls for a maximum width of six feet from the curb, and a maximum length of two parking spaces, or 44 feet where not otherwise marked (Parklet Program Pilot Extension, 2014). In contrast, NACTO's guidelines call for a *minimum* width of six feet and give no limit on length, going so far as to discuss the accessibility and safety issues of block-long parklets (Urban Street Design Guide: Parklets, 2015). The San Francisco Planning Department's guidelines make no mention of length or width, except to say that a parklet's size should be equivalent to one or more parking spaces, while maintaining a four foot buffer between the parklet and the edge of the parking space on either side (San Francisco Parklet Manual, 2015).

Only San Francisco and Oakland's guidelines address vertical features. Oakland recommends a 42-inch minimum railing height along three sides of the parklet with openings no larger than four inches. The city also recommends that these edges be permeable or transparent to improve safety and deter vandalism (Parklet Program Pilot Extension, 2014). San Francisco, meanwhile, calls for only one edge of the parklet to act as a buffer from the street, and suggests using planters, cabling, or a railing to delineate this buffer (San Francisco Parklet Manual, 2015). Significantly, San Francisco's guidelines exempt low-traffic streets from requiring a contiguous edge, allowing for the possibility of a hybrid parklet/bus bulb design. All three guidelines call for the parklet to be flush with the sidewalk and for the gap between the parklet and the curb to not exceed 0.5 inches.

Table 5: Bus Stop Dimensions

AC Transit	Better Streets San Francisco	NACTO	Transport for London	SEPTA	TCRP
at least 60 feet long (allowing passengers to board/alight from all doors) width depends on many factors (width of travel lanes, presence of bike lanes, need for sidewalk space)	should be long enough to accommodate all doors of transit vehicles plus an additional 5 feet of maneuvering space Where there is frequent service, bulbs should be long enough to accommodate two or more vehicles, with 5 feet of space in between should leave 10 feet at back of bus zone to prevent following cars from blocking intersection	length = ~2 bus lengths for frequent service routes (~140'), >1 bus length for less frequent service (~30') width = roughly equal to the width of the parking lane with a return angle of 45 degrees.	project far enough into street for bus to avoid maneuvering past parked vehicles >2m wide next to car parking and >2.6m wide next to goods vehicles/vans length depends on vehicle types that serve the stop and bus frequency (>3m long at small bus serving stop without a shelter) not used at high frequency stops where they will cause delay to following buses provide space for shelters designed and constructed to allow for street and sidewalk drainage need to leave an unobstructed width of >2m for pedestrians unobstructed widths of >3m should contain a bus shelter	seven square feet per person net area net area is area not including pedestrian pathways and bus loading pad	5 feet of clearance should be preserved on sidewalks to reduce potential pedestrian conflicts and limit congestion during boardings and alightings the bus bulb can be located on either side of the sidewalk, depending on available right-of-way space, utility poles, or buildings provide a paved surface from the waiting pad to the curb to enhance access and comfort length of the pad should be based on the anticipated length of the bus that will use the bus stop and the number of buses that will be at the stop simultaneously

Table 6: Parklet Dimensions

City of Oakland	NACTO	SF Planning Department	UCLA Luskin
max of 6’ width from curb not to exceed length of 2 parking spaces (Where spaces are not marked, a parking space is 22’ long; 20’ long adjacent to a red zone) flush with curb, ½” gap maximum along roadway, railing height of 42” minimum with openings, so that a sphere no larger than 4” can pass visible vertical edge on three street sides, sidewalk side should be fairly open for accessibility vertical edges should be visually permeable or “see-through” to deter graffiti and allow for safety	width >6 feet (around the width of the parking lane) length reflects size/number of converted parking spaces (one or more parallel parking spaces or 3–4 angled parking spaces) when parklet stretches length of an entire curb, accessibility and sightlines must be considered	sidewalk and the platform must be flush with <1/2" horizontal or vertical separation changes in level shall not exceed 1/2" and slope should not be steeper than 1:4 (25%) if located in front of driveway or curb ramp, slope must be levelled for the duration of parklet’s installation parklet should have one edge as a buffer from the street, which can be in form of planters, railing, cabling, or other enclosure height and scale of buffer depends on local context (low-traffic streets don't require a continuous edge) if cable railing is used, spacing between cables should be <5"	dependent on city

DRAINAGE

There are few drainage requirements in either bus stop or parklet guidelines. Several bus stop guidelines call for “good” or “proper” drainage (Guidelines for the Location and Design of Bus Stops, 1996) (Accessible Bus Stop Design Guidance, 2006), and others recommend that stops not be located in places where passengers have to step over catch basins or walk through grass or soil to reach the stop or bus (Guidelines for the Location and Design of Bus Stops, 1996) (Designing with Transit: Making Transit Integral to East Bay Communities, 2004) (Transit Stops, 2015). The SF Better Streets Plan stipulates that permeable paving, planters, and covered channels all constitute appropriate bus stop storm-water drainage facilities (Transit Stops, 2015).

Parklet drainage guidelines generally consist of warnings that the structure should not impede existing curbside storm-water drainage (San Francisco Parklet Manual, 2015) (Parklet Program Pilot Extension, 2014) (Urban Street Design Guide: Parklets, 2015). Brozen and Loukaitou-Sideris’ booklet recommends explicitly restricting the parklet base from being built alongside the curb (Anastasia Loukaitou-Sideris M.

B., 2012), while the SF Planning Department recommends putting a screen at either end of the drainage flow to prevent the accumulation of debris beneath the structure (San Francisco Parklet Manual, 2015).

Table 7: Bus Stop Drainage

APTA	Better Streets San Francisco	Transport for London	TCRP
should not be located so that passengers are required to step over catch basins	should not impede the ability to access the transit shelter or boarding areas transit-appropriate storm water facilities include: permeable paving, building-adjacent planters, or covered channels	it is important that good drainage be provided to prevent "ponding" at the curb, which can result in passengers being splashed by passing traffic	The bus bulb waiting pad should have proper drainage passengers should not have to walk through grass or exposed soil to reach the bus

Table 8: Parklet Drainage

City of Oakland	NACTO	SF Planning Department	UCLA Luskin
maintain curb line drainage	design should not inhibit storm water drainage small channels between base and platform facilitate drainage	cannot impede the flow of curbside drainage drainage openings should be covered at either end with screens to prevent debris buildup beneath deck and in gutter	constructed through a sub-structure with a platform constructed on top sub-structure must account for street crown (in order to create a level platform) it is important to maintain curbside drainage by not placing any sub-structure directly next to the curb

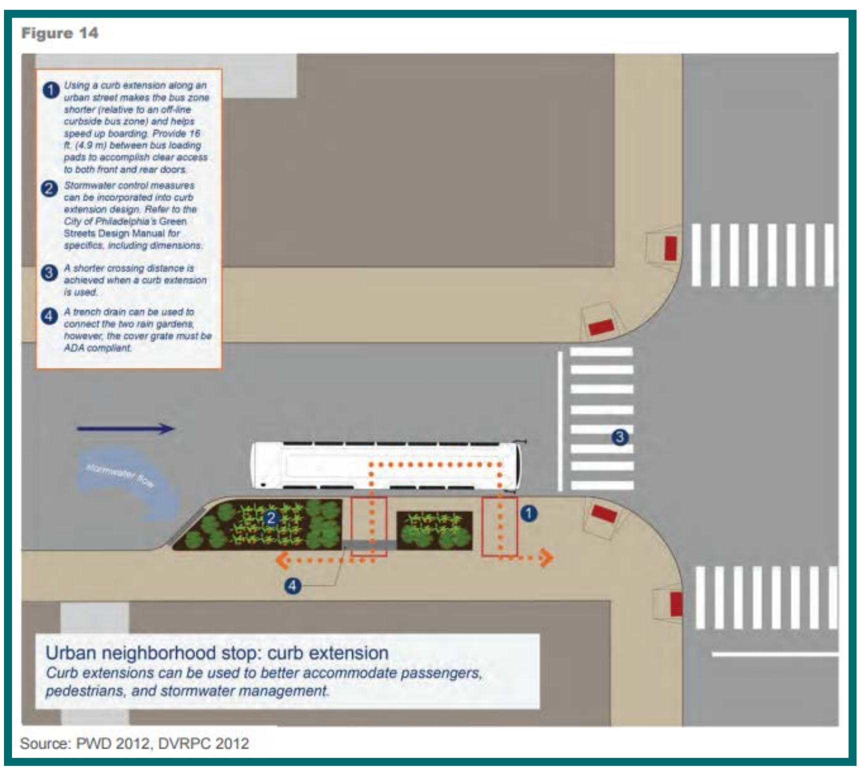
LANDSCAPING

There is a general consensus in the literature that landscaping can be a positive feature for both bus stops and parklets. The only concerns revolve around the potential for criminal activity and obstruction of travel. In its bus stop guidelines, AC Transit warns that landscaping should not allow for anyone to hide, nor should it create blind spots for either the bus driver or those waiting at the bus (Designing with Transit: Making Transit Integral to East Bay Communities, 2004). Some agencies have specific height limits that they recommend landscaping not exceed. APTA recommends that foliage grow no higher than 2-3 feet and no lower than 6-7 feet (Bus Stop Design and Placement Security Considerations, 2010), while SEPTA recommends foliage grow no higher than 2 and no lower than 9 feet (see Figure 5)

(SEPTA Bus Stop Design Guidelines, 2012). The SF Better Streets Plan stipulates that landscaping not interfere with pedestrian or vehicle movement and that all plantings should be distinct from other street trees and plants to differentiate the space as a transit stop (Transit Stops, 2015). TCRP's guidelines note how landscaping can improve the waiting experience by acting as a wind break (Guidelines for the Location and Design of Bus Stops, 1996).

Parklet guidelines also emphasize the benefits of landscaping. Brozen and Loukaitou-Sideris explain that landscaping and planters can serve to protect the site from vehicles, distinguish the space from other parts of the street, and even provide shade for its users (Anastasia Loukaitou-Sideris M. B., 2012). Both Brozen and Loukaitou-Sideris and the SF Planning Department recommend native and drought tolerate plants be used in any landscaping to provide animal habitat, consume less water, and keep decking from getting weighed down (Anastasia Loukaitou-Sideris M. B., 2012) (San Francisco Parklet Manual, 2015).

Figure 5: A Landscaped Bus Stop Design



(SEPTA Bus Stop Design Guidelines, 2012)

Table 9: Bus Stop Landscaping

AC Transit	APTA	Better Streets San Francisco	NACTO
should be free of locations where someone can hide should not create blind spots that obstruct view of a bus driver or passenger	should not interfere with clear lines of sight foliage should be no lower than 6-7 feet and no higher than 2-3 feet should not create areas where items or people can be hidden	may be used to distinguish transit stop from adjacent sidewalk area, but should not interfere with transit operations/pedestrian travel if planted, should be different alignment and tree type from existing sidewalk trees (most appropriate along rapid transit routes and major transfer points)	cities may enhance major bus stops through shelters, benches, area maps, plantings, vendors, or artwork

Table 10: Parklet Landscaping

SF Planning Department	UCLA Luskin
integrated planting strongly encouraged native plants, plants that provide habitat, and drought tolerant plants are encouraged	landscaping elements should serve as bollards in order to both delineate space and protect site from vehicles use resilient, drought-tolerant plants, as water can weigh down decking us plants that grow vertically instead of laterally because they can provide shade and take up less space

LIGHTING

Lighting is generally seen as a tool to deter crime, especially at night (Bus Stop Design and Placement Security Considerations, 2010). As a cost-effective strategy, many bus stop guidelines suggest placing bus stops next to existing streetlamps wherever convenient (Guidelines for the Location and Design of Bus Stops, 1996) (Transit Stops, 2015) (SEPTA Bus Stop Design Guidelines, 2012) (Bus Stop Design and Placement Security Considerations, 2010). But if no streetlamp exists at a proposed stop, lighting should be installed. In particular, existing bus shelters and signage should be illuminated (SEPTA Bus Stop Design Guidelines, 2012) (Transit Stops, 2015). Various guidelines also call for lighting to be bright (Designing with Transit: Making Transit Integral to East Bay Communities, 2004) (SEPTA Bus Stop Design Guidelines, 2012) (Guidelines for the Location and Design of Bus Stops, 1996), downward facing (Bus Stop Design and Placement Security Considerations, 2010), and vandal-proof (Bus Stop Design and Placement Security Considerations, 2010) (Guidelines for the Location and Design of Bus

Stops, 1996). Only SEPTA's guidelines recommend using energy-efficient lighting, including solar and lights with daylight-sensing equipment (SEPTA Bus Stop Design Guidelines, 2012).

Parklet guidelines make similar recommendations to those for bus stops. Brozen and Loukaitou-Sideris recommend that existing streetlights be used whenever possible, and emphasize the importance of illuminating the spaces at night (Anastasia Loukaitou-Sideris M. B., 2012). Both UCLA and the SF Planning Department recommend that lighting be powered with solar energy or another independent source to avoid the need to hook up to the power grid (Anastasia Loukaitou-Sideris M. B., 2012) (San Francisco Parklet Manual, 2015).

Table 11: Bus Stop Lighting

AC Transit	APTA	Better Streets San Francisco	NACTO	Transport for London	SEPTA	TCRP
should be safe, sufficient, and bright	stops with after-dark service should be located where they will be illuminated by an overhead streetlight if there is no street light present, lighting should be installed use multiple lights to provide consistent lighting and to reduce contrast place lighting where it will not be blocked by vegetation avoid placing unshielded light at eye level install lighting at height that resists vandalism use downward lighting	should be located in place that illuminates transit stop area, particularly in front of the stop and transit shelter may be provided by standard pedestrian or roadway lighting, where sufficient	adequate lighting should be installed around bus stops and shelters	good levels of illumination should be provided at bus stops to prevent issues of personal security	should provide 1.3-2.6 foot candles or 13 to 26 lux (typical light level at building entrance) a nearby street light can be used for stop-area lighting signage and shelter should be illuminated use efficient lamps, solar power, and daylight sensing equipment whenever possible	install lighting that provides between 2 to 5 foot candles when installing direct lighting at a bus stop, the fixtures should be vandal-proof but easily maintained a cost-effective approach to providing indirect lighting at a site is to locate bus stops near existing street lights

Table 12: Parklet Lighting

SF Planning Department	UCLA Luskin
lighting elements are strongly encouraged, but solar-powered lighting is recommended to avoid time and expense involved in running electricity from an adjacent building	parklets should feature lighting at night, which can be fulfilled by locating it near street lamps lighting can be incorporated in a number of creative and environmentally sensitive ways such as LED or solar

MATERIALS

Bus stop guidelines are not specific in terms of the materials that should be used, but several guidelines call for materials to be durable, slip-resistant and easily maintained (Guidelines for the Location and Design of Bus Stops, 1996) (Accessible Bus Stop Design Guidance, 2006) (SEPTA Bus Stop Design Guidelines, 2012). TCRP's guidelines also recommend that this material be impervious (Guidelines for the Location and Design of Bus Stops, 1996). Transport for London's guidelines recommend the use of special curbing to help guide the bus to a location that makes it easy for passengers to board and alight (Accessible Bus Stop Design Guidance, 2006). TCRP is the only organization to recommend specific materials for bus stop amenities, including wood for benches, metal for shelters, benches, bike racks, and trash receptacles, plastic for shelter panels and roofs, and tempered glass for shelter side panels (Guidelines for the Location and Design of Bus Stops, 1996).

Parklet guidelines are far more specific in the materials they recommend. According to the literature, parklet platforms are best constructed in one of two ways: 1) out of concrete with a plastic slip-sheet underneath to keep the base from binding to the roadway, or 2) out of a separate platform and sub-structure that are nailed or screwed together (Anastasia Loukaitou-Sideris M. B., 2012) (Urban Street Design Guide: Parklets, 2015). If constructed out of concrete, guidelines recommend that the structure not include rebar and weigh less than 200 pounds a square foot (San Francisco Parklet Manual, 2015) (Anastasia Loukaitou-Sideris M. B., 2012). If constructed out of a platform and sub-structure, guidelines recommend using either wood (preferably redwood or cedar) or steel with a "Bison" pedestal system for the sub-structure (see Figure 6) and slip-resistant, pre-treated wood for the platform (Anastasia Loukaitou-Sideris M. B., 2012) (Urban Street Design Guide: Parklets, 2015). If the platform is not a solid mass, SF Planning's parklet manual recommends that the space underneath the platform be easily accessible for maintenance (San Francisco Parklet Manual, 2015). Other recommendations include that the parklet not be made out of loose materials (San Francisco Parklet Manual, 2015), that it be constructed in such a way that graffiti and damaged parts can be easily removed (San Francisco Parklet Manual, 2015), and that it be designed to sustain at least 100 pounds per square foot (Urban Street Design Guide: Parklets, 2015). The City of Oakland's design parameters also note that all materials should be high quality, durable, and aesthetically pleasing (Parklet Program Pilot Extension, 2014).

Figure 6: A Bison Pedestal System

(Bison Innovative Products: Commercial & Residential, 2015)

Table 13: Bus Stop Materials

Transport for London	SEPTA	TCRP
the street and curb next to the bus stop are subject to particular stresses from repeated bus maneuvers and should thus be made of materials that are durable and easily fixable because it can be difficult for bus drivers to position their vehicles close to traditional curbs, special curbs such as 'Kassel' curbs, can be installed to reduce step height and to help guide the bus into a position with less of a gap between the bus and sidewalk	detectable edge at the curb line well-defined waiting and loading areas speed up passenger movements surface area that is durable, slip resistant, and free of obstructions/tripping hazards	the bus bulb waiting pad should be constructed of impervious non-slip material various materials can be used to construct a bus stop; the best materials are those that are weather resistant, can withstand continual use, and can be easily maintained primarily, wood, metal, concrete, glass, and plastics are used at bus stops Wood is best used for benches; metal is frequently used to construct shelters, benches, bike racks, and trash receptacles; metal, in combination with a plastic coating, is a good material for benches; concrete is best used for paving; plastic is used for paneling and roofing on shelters; tempered glass is primarily used for side panels on shelters

Table 14: Parklet Materials

City of Oakland	NACTO	SF Planning Department	UCLA Luskin
material to be high quality, durable, and attractive	should be heavy enough to make theft impossible or unlikely sub-structure must accommodate crown of the road and provide level surface for parklet ("Bison pedestals," steel sub-structure, and angled beams are commonly used) should use slip-resistant surface to minimize hazards floor load-bearing weight standards vary by agency, but should be designed to sustain >100 pounds/square foot	if using concrete, must use a plastic slip-sheet to prevent concrete from binding to the roadbed below (to facilitate easy removal of parklet, concrete should not include structural rebar and must weigh <200 pounds/square foot) loose particles (i.e. sand or loose stone) are not permitted on the parklet if platform base is not a solid mass, clear space underneath platform must be accessible for maintenance through access panels, removable pavers, etc. must have strategy for removing graffiti, and replacing/repairing damaged parklet features such as plants, railings, or other elements pressure treated lumber or plywood wood are not allowed in places where they will be visible	structure typically constructed with pedestal system (Bison) and a steel sub-structure with angled crossbars for platform (Fabric8, Rebar) wood can also be used to construct sub-structure (unfinished cedar or redwood weather well and do not require maintenance or refinishing) platform can also be made of either permeable pre-cast concrete pavers or pre-treated wood structure can also be made using concrete poured over a slip-sheet (to prevent bonding to the street), which is cost-effective, durable, portable, and eliminates the need for cleaning underneath

SAFETY FEATURES

The literature on bus stop and stoplet guidelines emphasizes several recommendations to ensure safety from both crime and vehicle crashes. According to the guidelines, bus stop crime can be mitigated first and foremost by locating bus stops near active land uses, such as businesses, schools, libraries, and housing (Guidelines for the Location and Design of Bus Stops, 1996) (Designing with Transit: Making Transit Integral to East Bay Communities, 2004) (Transit Stops, 2015) (Accessible Bus Stop Design Guidance, 2006). Bus stops should also have good lighting, and should not be obscured by nearby trees, poles, or buildings (Guidelines for the Location and Design of Bus Stops, 1996). To further ensure safety, amenities should minimize the amount of hiding spaces and not hinder visibility (Bus Stop Design and Placement Security Considerations, 2010). This includes landscaping and bus shelters, which should be built with transparent and graffiti-resistant glass panels (Bus Stop Design and Placement Security Considerations, 2010) (Guidelines for the Location and Design of Bus Stops, 1996). Ideally, bus drivers and pedestrians have a clear line of sight when approaching the stop and 360-degree visibility when at the stop at all times (Bus Stop Design and Placement Security Considerations, 2010).

Like bus stop guidelines, parklet guidelines call for surrounding land uses that support pedestrian activity (Anastasia Loukaitou-Sideris M. B., 2012). Brozen and Loukaitou-Sideris recommend that businesses adjacent to the parklet should be open at least during normal business hours, if not longer, and that the parklet be highly visible from the business' window (Anastasia Loukaitou-Sideris M. B., 2012).

In terms of safety from traffic, several guidelines call for a four-foot buffer on either end of the parklet, protected by a wheel stop and made visible with soft-hit posts or bollards (Urban Street Design Guide: Parklets, 2015) (Parklet Program Pilot Extension, 2014). NACTO recommends constructing a guardrail along the outside edge of the parklet to both define the space and protect against wayfaring vehicles. To maximize safety, NACTO's guidelines recommend this guardrail be built at least three feet high and be capable of withstanding at least 200 feet of horizontal force (Urban Street Design Guide: Parklets, 2015). A couple of guidelines also recommend that parklets not be placed at street corners to reduce the possibility of collisions (San Francisco Parklet Manual, 2015) (Urban Street Design Guide: Parklets, 2015), but if a municipality happens to approve of a parklet's street corner placement, turning traffic volumes, sightlines, and visibility should be considered (Urban Street Design Guide: Parklets, 2015).

Table 15: Bus Stop Safety Features

AC Transit	APTA	Better Streets San Francisco	Transport for London	TCRP
prioritize stops around active uses, such as stores, schools, or other facilities (over vacant lots or other inactive uses)	amenities should permit 360-degree visibility in and around the bus stop at all times a clear line of sight to the approaching bus should be available amenities should minimize hiding places for packages and people windbreaks and shelter glass should be designed with graffiti-resistant materials that provide sufficient visibility consider changes in grade, retaining walls or other obstructions that may create areas of concealment	stops should be integrated with adjoining activity centers wherever possible to activate/ create safe space	bus stops should be located near places of particular need, such as local shops, libraries, clubs, health facilities and housing	if the bus stop is obscured by nearby trees, poles, or buildings, it may be present a safety hazard to bus operators, motorists, bicyclists or pedestrians bus stop shelters should be constructed of materials that allow clear, unobstructed visibility of and to patrons waiting inside bus stops should be at highly visible sites that permit approaching bus drivers and passing vehicular traffic to see the bus stop clearly landscaping elements that grow to heights that would reduce visibility into and out of the bus stop should be avoided; low-growing shrubbery and ground cover and deciduous shade trees are preferred at bus stops bus stop should be coordinated with existing street lighting to improve visibility bus stops should be next to existing land uses, such as stores and businesses, to enhance surveillance of the site

Table 16: Parklet Safety Features

City of Oakland	NACTO	SF Planning Department	UCLA Luskin
4’ distance from parklet to wheel stop 3’ wheel stop installed 1’ from curb reflective soft hit posts	must be buffered using a wheel stop 4 feet from parklet to ensure car visibility 4 foot buffer may also serve as space for adjacent property owners to accommodate curbside trash collection should have vertical elements that make it visible to traffic (i.e. flexible posts, bollards) select location based on level of surveillance during both the day and night avoid placing at corners (best placed at least one parking space away from intersection corner) if placed near an intersection, volumes of turning traffic, sightlines, visibility, and daylighting should be taken into account open guardrail should define space (railings should be <3' high and capable of withstanding >200' of horizontal force	locate away from a street corner along a street with a speed limit of 25mph or less must not extend beyond six feet from the curb line in places where there is parallel parking	surrounding land uses should support pedestrian activity (include commercial, high-density residential and mixed-use areas) should be highly visible from inside adjacent business (provides “eyes on the street” to support user safety) adjacent businesses should be open during normal business hours or longer

SEATING

Bus stop seating guidelines tend to be far more particular than their parklet guideline counterparts. Several bus stop guidelines are explicit that seating not be placed in a way that obstructs wheelchair movement, especially within the designated wheelchair landing pad (Bus Stop Design and Placement Security Considerations, 2010) (Guidelines for the Location and Design of Bus Stops, 1996) (Transit Stops, 2015). APTA’s guidelines call for seating to be placed facing the street and at least six to nine feet behind the bus stop signpost to ease pedestrian flow (Bus Stop Design and Placement Security Considerations, 2010), while TCRP’s guidelines recommend a buffer of only two feet from the curb (Guidelines for the Location and Design of Bus Stops, 1996). SF Better Streets’ guidelines specify that there should be seating underneath the shelter when a shelter is present, but that alternative seating is permissible as long as there is a clear path of travel (Transit Stops, 2015). SF Better Streets and SEPTA’s guidelines both detail alternative seating options, which can be in the form of bollards, low-seat walls and ledges, leaning bars, and even cylindrical seating spaces (Transit Stops, 2015) (SEPTA Bus Stop Design Guidelines, 2012). Other considerations in determining where to locate seating include whether the area is shaded, illuminated, and sufficiently protected from the elements (Guidelines for the Location and Design of Bus Stops, 1996).

In terms of the seating itself, both APTA and SEPTA recommend that the materials used be strong, durable, and weather-, graffiti, and fire-resistant (Bus Stop Design and Placement Security Considerations, 2010) (SEPTA Bus Stop Design Guidelines, 2012). APTA also calls for seating to be anchored to the ground yet easy to relocate of the stop changes locations (Bus Stop Design and Placement Security Considerations, 2010). SEPTA recommends that all seating include arms to both assist seating and deter sleeping, and specifies that this seating by at least 6.5 feet in length (or the equivalent of three seats) (SEPTA Bus Stop Design Guidelines, 2012). AC Transit has no specifications for bus stop seating, except to recommend that there be "a bench at which to wait" (Designing with Transit: Making Transit Integral to East Bay Communities, 2004).

Parklet guidelines have divergent but compatible recommendations. The majority of parklet guidelines call for a portion of parklet seating to be a permanent feature of the space (San Francisco Parklet Manual, 2015) (Anastasia Loukaitou-Sideris M. B., 2012) (Urban Street Design Guide: Parklets, 2015). Both Brozen and Loukaitou-Sideris and the San Francisco Planning Department recommend that portable seating also be incorporated into a parklet's design, but stipulate that these tables and chairs be distinct from the adjacent restaurant's to emphasize the public nature of the space (Anastasia Loukaitou-Sideris M. B., 2012) (San Francisco Parklet Manual, 2015). Finally, Brozen and Loukaitou-Sideris also recommend all portable seating to be light, durable, and easy to remove (Anastasia Loukaitou-Sideris M. B., 2012).

Table 17: Bus Stop Seating

AC Transit	APTA	Better Streets San Francisco	Transport for London	SEPTA	TCRP
there should be a bench at which to wait	should be placed facing the street structure and materials should be strong and durable materials and paint should be resistant to weather, graffiti, cutting, and fire design should be neighborhood appropriate should be placed on the back side of the sidewalk (>6-9 feet from bus sign post) to ease pedestrian flow ensure no conflicts with wheelchair accessibility and loading should be anchored construct for easy relocation to accommodate changes	should be located within the transit shelter when one is present formal (benches, seats with armrests) or informal (bollards, low seat walls, leaning bars) seating can be placed outside of the shelter if it provides a path of travel to the shelter and boarding area	the space between the flag and 20m upstream should be kept clear of street furniture	should be made of a durable material, resistant to vandalism and wear from exposure to weather should be ADA-compliant in dimension, with a recommended minimum length of 6.5 ft (3 seats) arms are important to assist seniors and disabled anti-sleeping bars are recommended other forms of seating can also be used (including a large diameter tube or ledge about 2.5 ft high or a low masonry wall)	avoid locating benches in completely exposed locations; coordinate bench locations with existing shade trees if possible; otherwise, install landscaping to provide protection from the wind and other elements coordinate bench locations with existing street lights to increase visibility and enhance security at a stop locate benches on a non-slip, properly drained, concrete pad; avoid locating benches in undeveloped areas of the right-of-way locate benches away from driveways to enhance patron safety and comfort maintain a minimum separation of 2 feet (preferably 4 feet) between the bench and the curb maintain general ADA mobility clearances between the bench and other street furniture or utilities at a bus stop do not install the bench on the 5-foot by 8-foot wheelchair landing pad at bench-only stops, additional waiting room near the bench should be provided (preferably protected by landscaping)

Table 18: Parklet Seating

NACTO	SF Planning Department	UCLA Luskin
may be integrated into design itself or made possible with moving tables and chairs	should include some permanent seating integrated into parklet structure to ensure parklet still feels welcome after moveable furniture like tables and seating are taken inside at night movable tables, chairs and benches must be different from furniture currently used inside business and/or on sidewalk as part of Café Tables and Chairs Permit	removable furniture should be durable, light, and easy to remove built-in seating should also be included (without it, parklet looks very bare when seating is stored inside adjacent business) if parklet is located adjacent to a café or restaurant, tables and chairs should not be same style as those inside the business, as this visually distinguishes parklet seating as separate from private business)

SHELTER

Bus stop design guidelines as they pertain to bus shelters are extensive. Several guidelines call for shelters to be made out of strong, durable, and easily cleanable materials (Bus Stop Design and Placement Security Considerations, 2010) (SEPTA Bus Stop Design Guidelines, 2012) (Guidelines for the Location and Design of Bus Stops, 1996), and for the sides of the shelter to be transparent so as to allow both the operator and passenger to easily see both inside and out (Bus Stop Design and Placement Security Considerations, 2010) (Guidelines for the Location and Design of Bus Stops, 1996) (SEPTA Bus Stop Design Guidelines, 2012). SEPTA's guidelines require a roof and at least two enclosed sides to protect passengers from the wind and other elements (SEPTA Bus Stop Design Guidelines, 2012). APTA's guidelines recommend that the transit agency consider the roof's greenhouse effect during warm weather before installing a shelter (Bus Stop Design and Placement Security Considerations, 2010), and both APTA and TCRP's guidelines call for neighborhood-specific shelter designs (Bus Stop Design and Placement Security Considerations, 2010) (Guidelines for the Location and Design of Bus Stops, 1996).

In terms of shelter size, the SF Better Streets Plan specifies a range for both length and width, recommending shelter widths between 3-7 feet and lengths between 8.5-16.5 feet (Transit Stops, 2015). SETPA's guidelines, meanwhile, call for shelters to be sized in such a way that reflect passenger volumes (SEPTA Bus Stop Design Guidelines, 2012). Finally, APTA recommends that shelters be large enough to accommodate wheelchairs (Bus Stop Design and Placement Security Considerations, 2010).

In regard to shelter placement, several guidelines call for shelters to be placed at the front of the bus stop, for better visibility and to indicate where passengers should board (Designing with Transit: Making Transit Integral to East Bay Communities, 2004) (Transit Stops, 2015) (Guidelines for the Location and Design of Bus Stops, 1996). While the SF Better Streets Plan recommends that shelters be placed toward the front of the stop, it also calls for a five-foot buffer between the front of the stop and the shelter to provide for an accessible five-foot by eight-foot landing pad (Transit Stops, 2015). TCRP recommends that there be a three-foot buffer between the shelter and the adjacent sidewalk and a two-foot buffer between the shelter and the curb (Guidelines for the Location and Design of Bus Stops, 1996). The SF Better Streets Plan recommends this buffer between the shelter and the curb to be four feet unless a panel is removed from the shelter that is wide enough to accommodate a wheelchair (Transit Stops, 2015). In terms of where *not* to place shelters, TCRP advises that shelters not be placed in an area that impedes pedestrian traffic or in front of a store window, obstructing passers-by view of the store (Guidelines for the Location and Design of Bus Stops, 1996), while AC Transit stipulates that shelters not be place in front of automatic teller machines (ATMs) (Designing with Transit: Making Transit Integral to East Bay Communities, 2004). A few guidelines also recommend shelters to be prioritized at stops with high levels of boarding (Urban Street Design Guide: Bus Bulbs, 2015) (Guidelines for the Location and Design of Bus Stops, 1996).

In terms of shelter amenities, agencies differ on what to include. Transport for London emphasizes the need for lighting to improve the perception of personal safety (Accessible Bus Stop Design Guidance, 2006), the SF Better Streets Plan requires real-time information and a push-to-talk button (Transit Stops, 2015), and AC Transit calls for a map, schedule, leaning rail, phone, and benches at every shelter (Designing with Transit: Making Transit Integral to East Bay Communities, 2004). TCRP recommends benches specifically at low-frequency stops (Guidelines for the Location and Design of Bus Stops, 1996).

Parklet guidelines, in contrast to bus stop guidelines, make little mention of shelters. Brozen and Loukaitou-Sideris recommend that parklets be shaded during the day, but note that trees and umbrellas can provide this shade. SF Planning's manual stipulates that if shelters are included in a parklet design, they must be at least 80 inches tall (San Francisco Parklet Manual, 2015).

Table 19: Bus Stop Shelter

AC Transit	APTA	Better Streets San Francisco	NACTO	Transport for London	SEPTA	TCRP
should be sited as close as possible to the bus stop flag should include places to sit, map of area routes and schedules, leaning rails (if possible), and phone that can make outgoing calls (if possible) should also not be placed directly in front of ATMs locations should be jointly determined by agency and city controlling the sidewalk	use materials easily cleaned and/or resistant to vandalism and weathering (perforated metal sheeting or other metal semi-transparent applications) use materials resistant to breaking or apply treatments that mitigate breakage (film and/or glazing) use strong and durable materials consider the greenhouse effect of roof design during hot weather consider neighborhood specific design use enclosure that allows bus operator to see inside shelter create marking indicating space dedicated for wheelchairs	should be located toward the front of the stop to indicate where customers should wait to board the vehicle should be placed ~5 ft behind front of stop to allow for accessible boarding area (5 ft x 8 ft) should be located to provide >4 ft of clear space between edge of the curb and front edge of shelter (unless another accessible path is provided, such as by removing one of the back panels of the transit shelter) shelters can also be placed in frontage zone as long as they don't block building entrances must use approved Muni transit shelter design, including real-time transit information, route maps, and a push-to-talk button (exceptions may be considered) widths vary from 3'-7' lengths vary from 8' 6"-16' 6" should be selected to fit the sidewalk context (narrower shelters on narrower sidewalks, larger shelters on LRT, BRT, or Rapid Network lines)	shelters should be provided for stops on routes with high boarding numbers	shelters with a half width or no end panel on the bus approach side are recommended, because this improves visibility shelters generally consist of between 1 and 4 panels each of 1.3m in length, with end panels of either 1.3m (full width) or 0.65m (half width) lighting within the shelter can help to improve perception of personal safety	sized to reflect expected passenger volumes constructed of durable, architecturally sound materials to withstand heavy use and continual exposure to the elements have a roof be enclosed on at least two sides to provide a screen from winds a clear view of the approaching bus and bus loading pad is necessary oriented and enclosed to protect against exposure oriented toward the path that leads to the bus loading pad	shelters should be constructed of clear side-panels for clear visibility depending on demand and service frequency, they should have a bench suggested boarding levels for shelter suitability are 50 to 100 boardings per day should not be placed in the 5-foot-by-8-foot wheelchair landing pad should not be located directly on the sidewalk or overhanging a nearby sidewalk to avoid restricting general pedestrian traffic >3 feet should be maintained around the shelter and an adjacent sidewalk >2 feet should be maintained between the curb and the roof or panels of the shelter should be located as close to the end of the bus stop zone as possible so it is highly visible avoid locating shelters in front of store windows so as not to interfere with advertisements and displays different shelter configurations can be used to reflect site or regional characteristics should be coordinated with landscaping to provide maximum protection from the elements and to enhance the visual quality of the bus stop

Table 20: Parklet Shelter

SF Planning Department	UCLA Luskin
36" - 42" outer buffer 80" minimum overhead	parklets should feature shade during the daytime, which can be fulfilled by locating it near street trees shade can also be provided with umbrellas

SIGNAGE

Bus stop guidelines are fairly consistent about signage. According to the guidelines, signage should be double-sided and reflectorized (Guidelines for the Location and Design of Bus Stops, 1996) (SEPTA Bus Stop Design Guidelines, 2012), contain a font, color, and appearance unique to the transit system (Guidelines for the Location and Design of Bus Stops, 1996), and include bus route information, including the route number, route destination, and unique stop identification (SEPTA Bus Stop Design Guidelines, 2012). SEPTA's guidelines require sign dimensions to be 18 inches tall and 12 inches wide (SEPTA Bus Stop Design Guidelines, 2012).

As far as placement is concerned, the literature unanimously recommends that signage be placed close to where passengers board the front door (Guidelines for the Location and Design of Bus Stops, 1996) (Designing with Transit: Making Transit Integral to East Bay Communities, 2004) (Transit Stops, 2015) (Accessible Bus Stop Design Guidance, 2006) (SEPTA Bus Stop Design Guidelines, 2012). Several guidelines also call for the signpost to be located two or more feet from the curb's edge (Guidelines for the Location and Design of Bus Stops, 1996) (SEPTA Bus Stop Design Guidelines, 2012) (Designing with Transit: Making Transit Integral to East Bay Communities, 2004). TCRP recommends that the sign itself be posted at least seven feet high if posted on a pole, but also authorizes its placement on a street light or shelter, as long as the sign itself is not obstructed by trees, buildings or other signage (Guidelines for the Location and Design of Bus Stops, 1996). AC Transit recommends that the signpost be located at least eight feet from the bus shelter or bench (Designing with Transit: Making Transit Integral to East Bay Communities, 2004), while Transport for London calls for only a two-meter (or around six feet) distance between the two (Designing with Transit: Making Transit Integral to East Bay Communities, 2004). Finally, SEPTA recommends a two-foot distance between the signpost and the accessible landing pad (Designing with Transit: Making Transit Integral to East Bay Communities, 2004).

The only signage requirements in the parklet guidelines are signs indicating that the parklet is open to the public (San Francisco Parklet Manual, 2015) (Parklet Program Pilot Extension, 2014) (Anastasia Loukaitou-Sideris M. B., 2012). SF Planning and Oakland's guidelines call for two signs at each parklet (San Francisco Parklet Manual, 2015) (Parklet Program Pilot Extension, 2014).

Table 21: Bus Stop Signage

AC Transit	APTA	Better Streets San Francisco	Transport for London	SEPTA	TCRP
located 18-24 in from curb of the sidewalk/bus island, or from the curb at the narrowest width of the sidewalk/bus island should align with approximate location of front bumper of bus >96 in clear space between pole and base of the bus shelter/bench	must be securely mounted on its own post or a light perpendicular to the street must be easily visible to approaching bus driver, (within 4 feet of street edge) should neither block nor be blocked by other signs should be placed at a sufficient distance from the curb but should not impede pedestrian travel should be located approximately 1 foot beyond where the front of the bus stops bottom of sign should be at least 80 inches from the ground should at least contain names of routes along stop and a telephone number to call for more info should comply with ADA standards	flag signs should be placed near the front of the stop, to indicate where passengers should wait to board vehicle	the layout of the passenger waiting area should be based around the position of the bus stop flag, which indicates where passengers should wait the flag also serves as a marker to drivers to indicate where the bus should be positioned at the stop (with the rear of the front doors in line with the flag) the flag should be 2m from one end of the bus shelter	double-sided sign on its own pole located near bus stopping point to aid people who are visually impaired sign dimensions = 18 inches tall, 12 inches wide include bus route number, unique stop identifier number, and route destination points should be set back from the curb edge two feet and with two feet clearance from the bus loading pad	signs serve as a source of information and are excellent marketing tools letter styles, sign appearance, and color choice should be unique to the transit system so that passengers can readily identify bus stops should be double-sided and reflectorized for night time visibility should be placed at the location where people board the front door of the bus bottom of the sign should be at least 7 feet above ground level and should not be located closer than 2 feet from the curb face signs are also commonly located on a shelter or existing pole (such as a street light); they should not be obstructed by trees, buildings, or other signs

Table 22: Parklet Signage

City of Oakland	SF Planning Department	UCLA Luskin
required to install two "Public Parklet" signs provided by the City, which state that all seating is open to the public	required to have two "Public Parklet" signs that state that all seating is publicly accessible at all times	signage must convey to pedestrians that the space is public (rather than an extension of a business)

STREET CONDITIONS

The literature providing guidance on the appropriate street conditions for bus bulbs is fairly consistent, but agencies disagree on certain nuances. Several guidelines recommend that bus bulbs be installed on streets with low speeds, low traffic volumes, with high volumes of pedestrians (Bus Stop Design and Placement Security Considerations, 2010) (Accessible Bus Stop Design Guidance, 2006) (Guidelines for the Location and Design of Bus Stops, 1996) (SEPTA Bus Stop Design Guidelines, 2012). However, Transport for London and SEPTA restrict bus bulbs on streets above 30 miles per hour (Accessible Bus Stop Design Guidance, 2006) (SEPTA Bus Stop Design Guidelines, 2012), while AC Transit allows bus bulbs on streets as fast as 35 miles per hour (Designing with Transit: Making Transit Integral to East Bay Communities, 2004). Meanwhile, while other guidelines are silent on this issue, both the San Francisco Better Streets Plan and SEPTA's guidelines prohibit bus bulbs on streets with only one lane in each direction (although the Better Streets Plan makes exceptions on a case-by-case basis) (Transit Stops, 2015) (SEPTA Bus Stop Design Guidelines, 2012). SEPTA's guidelines also stipulate that bus bulbs should be prioritized on streets with narrow sidewalks and at bus stops that are located at the nearside of an intersection (SEPTA Bus Stop Design Guidelines, 2012).

Parklets are also recommended to be installed on streets with slow speed limits, low traffic volumes, and high pedestrian activity (Anastasia Loukaitou-Sideris M. B., 2012). And like bus bulb guidelines, the definition of "low" ranges, from 25 miles per hour (San Francisco Parklet Manual, 2015) (Anastasia Loukaitou-Sideris M. B., 2012) to 35 miles per hour (Philadelphia Parklet Program Guidelines). San Francisco's guidelines limit parklet installation to streets with a 5% grade or less (San Francisco Parklet Manual, 2015), while the City of Oakland's guidelines indicate that parklets should be built on streets with a "minimal" running slope (Parklet Program Pilot Extension, 2014). Both San Francisco and

Oakland's guidelines call for parklets to be built on streets with cross slopes of 2% or less (San Francisco Parklet Manual, 2015) (Parklet Program Pilot Extension, 2014). Finally, San Francisco's guidelines restrict parklets from being built on street corners, unless they are buffered by a pedestrian bulb, bike corral, or other barrier (San Francisco Parklet Manual, 2015).

Table 23: Bus Stop Street Conditions

AC Transit	APTA	Better Streets San Francisco	Transport for London	SEPTA	TCRP
should not be installed on high speed roads (>35 mph)	determined by pedestrian traffic, passenger volume, traffic volume, and crime rate	should be placed on streets with two or more lanes per direction so that vehicles may pass a stopped bus on the left (but may be considered on streets with one lane in each direction, on case-by-case basis)	on <30mph speed roads, bus bulbs should be considered if: 1) parked or loading vehicles cause operational problems for buses, or 2) buses have difficulty re-entering traffic in considering the suitability of a bus bulb, the agency should consider: a) street width, b) Average traffic flows, c) sight lines, d) bus frequencies, and e) the presence of a bus lane	less than 30 mph speed limit where pedestrian volumes are high where sidewalk is narrow and waiting space is required at near-side stops next to parking lanes on streets with multiple travel lanes	should be installed in places with high pedestrian activity, crowded sidewalks, reduced pedestrian crossing distances, and bus stops in travel lanes have particular application along streets with lower traffic speeds and/or low traffic volumes where it would be acceptable to stop buses in the travel lane should be designed to accommodate vehicle turning movements to and from side streets

Table 24: Parklet Street Conditions

City of Oakland	SF Planning Department	UCLA Luskin
should be on a street with a minimal running slope must not exceed a 2% cross slope	located on streets with <25 mph speed limits (>25 mph streets may be considered on a case-by-case basis) located at least one parking space away from an intersection or street corner (parklet near street corner may be considered if >15' bike corral, bulb out, or other barrier is closer to corner)	street should have low traffic speeds (typically 25 mph or less) should not be installed in areas with high traffic volumes should be placed on streets with existing pedestrian activity

SYSTEM INFORMATION

System information is important to reassure the customer of where they are, where they are going, and how to get there. The literature is generally consistent about what type of information is appropriate to put at bus stops and where to put it, with slight differences among guidelines. According to most organizations, bus stops should include a bus route, schedule, and map whenever possible (Bus Stop Design and Placement Security Considerations, 2010) (Urban Street Design Guide: Bus Bulbs, 2015) (Designing with Transit: Making Transit Integral to East Bay Communities, 2004). Other types of information to consider are a station name, agency logo, real-time information (Urban Street Design Guide: Bus Bulbs, 2015), fare structure, holiday schedule (Bus Stop Design and Placement Security Considerations, 2010), and services around the stop (Designing with Transit: Making Transit Integral to East Bay Communities, 2004). Several organizations recommend this information be posted in display cases (Bus Stop Design and Placement Security Considerations, 2010) (Designing with Transit: Making Transit Integral to East Bay Communities, 2004) (Accessible Bus Stop Design Guidance, 2006), while others recommend it be displayed inside the bus shelter (Guidelines for the Location and Design of Bus Stops, 1996) (Transit Stops, 2015). If displayed in cases, APTA recommends that there be ample space on all four sides to read the posted information, and that the bus schedule be posted on the side of the case facing away from the street (Bus Stop Design and Placement Security Considerations, 2010). AC Transit and TCRP guidelines also call for information to be displayed in large print (Designing with Transit: Making Transit Integral to East Bay Communities, 2004) (Guidelines for the Location and Design of Bus Stops, 1996), and AC Transit recommends all information be translated into Braille, Spanish and Chinese whenever possible (Designing with Transit: Making Transit Integral to East Bay Communities, 2004). No parklet design guidelines address the posting of information.

Table 25: Bus Stop System Information

AC Transit	APTA	Better Streets San Francisco	NACTO	Transport for London	TCRP
should have current route maps and schedule information for bus lines that stop at the bus stop info should be in alternative formats (large print, Braille, Spanish or Chinese) when possible display cases should contain location of the bus transit area, route maps, schedule information, and services surrounding the bus transit center, (intermodal connections, shopping centers, schools, recreation areas, and medical facilities)	at high-use stops, post route, schedule, info about fares and holiday schedule provide space on all four sides for passengers to inspect info schedules should be mounted on side away from street consideration should be given to mitigate vandalism and theft co-locate with CCTV systems	shelters must include real-time transit information, route maps, and a push-to-talk button	system info should include agency logo, station name, route map, and schedule real-time info systems may be added at bus stops to enhance rider experience and create a predictable travel experience	information posts (which display a bus timetable and other info) can be provided at locations that offer good bus accessibility provide reassurance to passengers that buses serve the route and can offer a source of information, such as the destination of buses encourage passengers to congregate, rather than wait at short distances from each other, so the bus can make a single stop	interior panels of shelters can be used to post route and schedule information; side panels may be large enough to display the entire system map and can include backlighting for display at night consider the quality and appearance of information displays make information displays permanent; temporary methods for displaying information create a cluttered, unsophisticated appearance at stop follow ADA clearance, mobility, and visual guidelines for access of information by individuals with impairments

ADDITIONAL AMENITIES

Other amenities to be considered for a bus stop include communication systems, ticket vending machines, bicycle storage facilities, and trash receptacles. Communications systems can take the form of telephones or emergency call boxes and should be located in high-traffic areas (Bus Stop Design and Placement Security Considerations, 2010) or at a location within sight of the bus stop (Designing with Transit: Making Transit Integral to East Bay Communities, 2004), but they should be located away from the bus stop waiting area (Guidelines for the Location and Design of Bus Stops, 1996) and not obstruct the sidewalk, landing pad, bus shelter, or system information (Bus Stop Design and Placement Security Considerations, 2010).

A ticket vending machine should be located near the bus shelter (Transit Stops, 2015), but not in the designated boarding or alighting zone (Accessible Bus Stop Design Guidance, 2006). It should also be anchored to the ground to deter theft or vandalism (Guidelines for the Location and Design of Bus Stops, 1996).

Bicycle storage facilities should be located away from pedestrian and passenger traffic to improve safety and mitigate congestion (Guidelines for the Location and Design of Bus Stops, 1996). Their view from the bus stop should not be obstructed and their location should be coordinated so that they are well illuminated at night (Guidelines for the Location and Design of Bus Stops, 1996) (SEPTA Bus Stop Design Guidelines, 2012).

Trash receptacles should be placed adjacent to the bus shelter (Transit Stops, 2015), at least two feet from the curb (Guidelines for the Location and Design of Bus Stops, 1996), and in a location that does not obstruct pedestrian movement (Accessible Bus Stop Design Guidance, 2006) or views of adjacent land uses (Guidelines for the Location and Design of Bus Stops, 1996). The receptacle should also be located away from the wheelchair landing pad, at least three feet from other street furniture, and in a place that does not encounter direct sunlight (Guidelines for the Location and Design of Bus Stops, 1996). Finally, it should be securely anchored to the ground and not be designed in a way that allows liquids to pool (Guidelines for the Location and Design of Bus Stops, 1996).

The only additional amenities mentioned in the various parklet guidelines are bicycle parking facilities. According to the guidelines, bicycle parking can either be mounted on top of the parklet platform, placed on the street adjacent to the parklet structure, or incorporated into the design of the parklet itself, pending sufficient space (San Francisco Parklet Manual, 2015) (Anastasia Loukaitou-Sideris M. B., 2012).

Table 26: Bus Stop Additional Amenities

AC Transit	APTA	Better Streets San Francisco	NACTO	Transport for London	SEPTA	TCRP
public telephone: locate at least one public telephone at stop or within sight of the bus transit area	communication systems: install emergency call boxes in high-traffic public areas should not obstruct access to the landing area, sidewalk, shelter or posted transit info newspaper boxes: should not be chained or otherwise affixed to the bus stop sign pole, shelter or bench	trash cans: should be placed adjacent to the transit shelter (where present bicycle storage: should be placed near back of the transit stop or outside of but adjacent to transit stop (Bike-share pods = outside of but adjacent to the transit stop) ticket vending machines: should be located near shelters within stop	cities may enhance major bus stops through shelters, benches, area maps, plantings, vendors, or artwork	ticket vending machines: location depends upon the type and location of the shelter, but they should not be located in the boarding and alighting zones trash cans: should be provided but should not be located in a space that creates a nuisance or obstructs pedestrian and passenger movement	bicycle storage: should be located in a well-lit, secure area to deter theft	ticket vending machines: should be anchored to the ground to reduce vandalism bicycle storage: locate away from other pedestrian or patron activities to improve safety and reduce congestion coordinate location with existing on-site lighting do not locate where views into the area are obstructed trash cans: anchor securely to the ground to reduce unauthorized movement. locate away from wheelchair landing pad areas and allow for >3-foot separation from other street furniture locate >2 feet from the back of the curb ensure it does not visually obstruct nearby driveways or land uses avoid installing that have ledges or other design features that permit liquids to pool avoid locating in direct sunlight phone: separate from bus stop waiting area by distance when possible follow general ADA site circulation guidelines

Table 27: Parklet Additional Amenities

SF Planning Department	UCLA Luskin
bicycle parking: can be incorporated into design through 1) custom bicycle racks integrated into the parklet structure, 2) on the parklet platform, or 3) on top of the parklet platform on-street adjacent to the parklet if incorporating bicycle corral into design, must leave a minimum of 15 feet of roadway space adjacent to the parklet for corral	bicycle parking: mount on top of the parklet platform, except when using pre-cast concrete pavers (because drilling into the paver degrades its strength) a bicycle corral can be installed in parklet site when there is ample space to do so

Suitability analysis

An ArcGIS suitability analysis was conducted to determine the best areas to locate stoplets in Oakland and Berkeley. The analysis seeks to give AC Transit a better idea of where this concept is locally applicable, and to provide a quantitative element to this research to complement the meta-analysis' more qualitative methodology. Alameda County transportation planners can either use the results of this analysis to directly inform where to focus their stoplet implementation efforts, or they can simply incorporate this analysis into the larger dialogue surrounding stoplet location. Ultimately, each stoplet's location should be collaboratively decided by the relevant city agency, the local community, and the adjacent small business or other entity that has agreed to maintain the space.

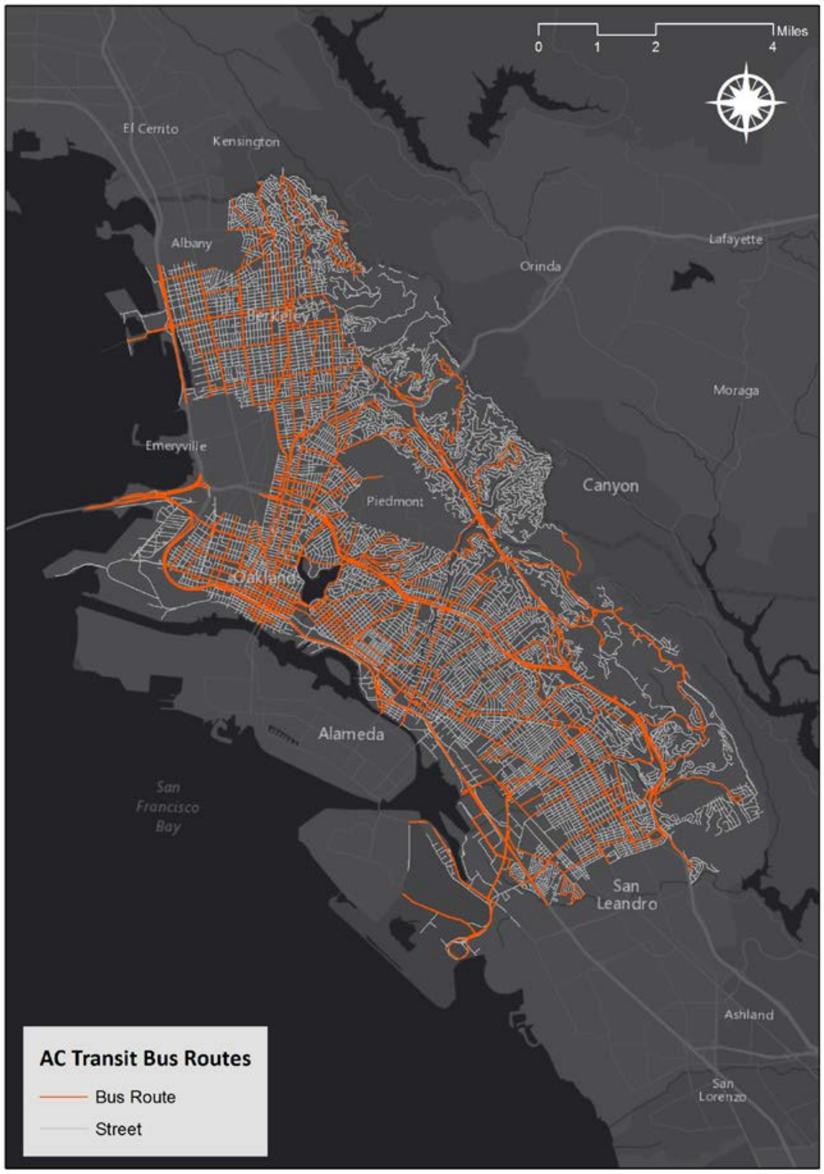
STOPLET CRITERIA

Existing Bus Stop Locations

The stoplet concept is predicated on the notion that bus stop design in Alameda County is insufficient in its current form, and that there are lessons to be learned from successful urban design interventions that might be applied to existing bus stops to improve the waiting experience. Thus, this project's scope is limited to existing bus stop locations throughout Alameda County. And because Oakland and Berkeley are the only two cities in Alameda County that have launched a parklet program to date, this project's scope is further confined to bus stops within these two cities.

According to data provided by AC Transit, there are 97 existing bus routes that travel through the cities of Oakland and Berkeley every day (see Figure 7), and 2,286 bus stops along these routes within the two cities. Unsurprisingly, bus lines tend to cluster around the two cities' downtowns, but also in Oakland's Temescal, Lake Shore, and Fruitvale Districts. This analysis evaluates each of the bus stops along these routes based on their stoplet suitability, using an index comprised of several factors that are individually detailed below.

Figure 7: AC Transit Bus Routes in Oakland and Berkeley

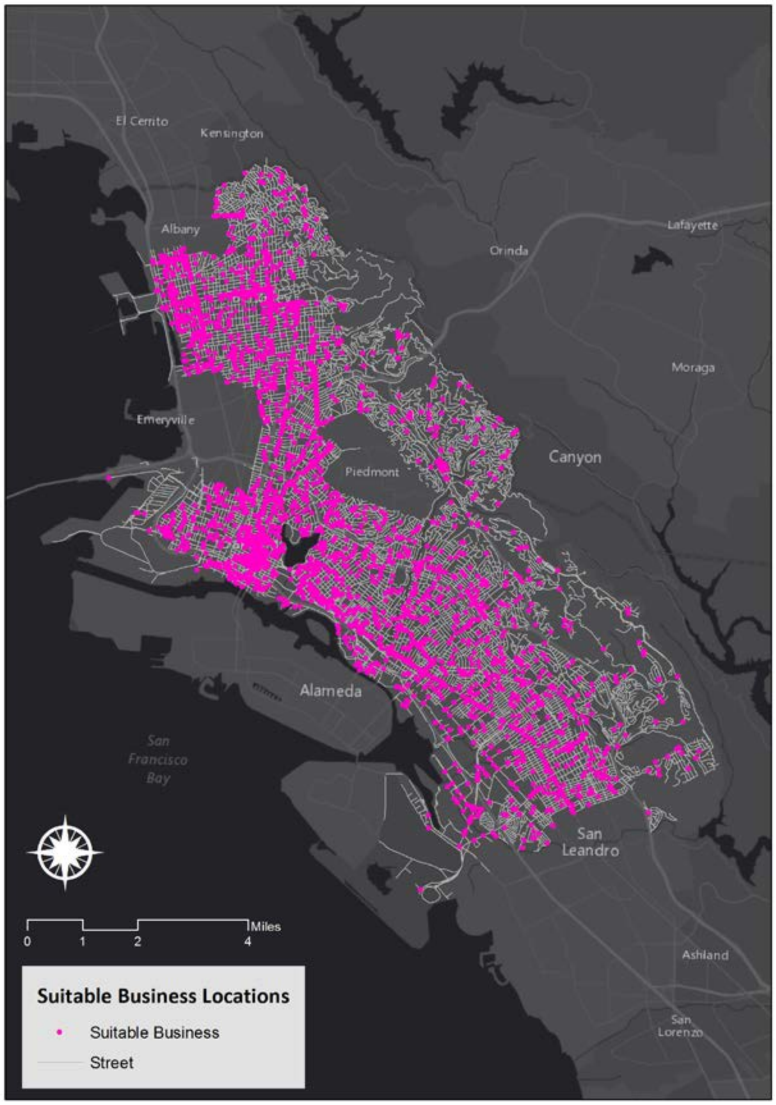


Proximity to Retail

Attracting "eyes on the street" is a notoriously effective strategy to ward off crime. Levine, Wachs, and Shirazi note this phenomenon at bus stops with large crowds of people (Levine, Wachs, & Shirazi, 1986), and evidence of its effectiveness has become a major selling point for parklet installation (Perri, 2013). Like parklets, stoplets would be similarly implemented through a partnership between the city and a local business owner whose business is adjacent to a bus stop.

In conducting the stoplet suitability analysis, I looked at retail businesses throughout the cities of Oakland and Berkeley (see Figure 8). I focused exclusively on retail businesses because existing data on parklets shows that an overwhelming majority of parklet sponsors are retail businesses (Pilaar, 2015), indicating that such a partnership would be the most likely model of success. Specifically, I filtered out the following retail business types from the NAICs data, which I determined to be the most amenable to stoplet installation: grocery stores; specialty foods stores; clothing and clothing accessory stores; sporting goods, hobby, musical instrument, and book stores; florists; office supplies, stationery, and gift stores; used merchandise stores; pet and pet supplies stores; art dealers; drinking places; and restaurants and other eating places. In looking at the map, business clusters appear to reflect bus route density, with major clusters in downtown Oakland and Berkeley. Other clusters include West Berkeley and along long commercial streets such as Temescal Avenue, College Avenue, Piedmont Avenue, University Avenue, San Pablo Avenue, and International Boulevard.

Figure 8: Retail Business Locations in Oakland and Berkeley

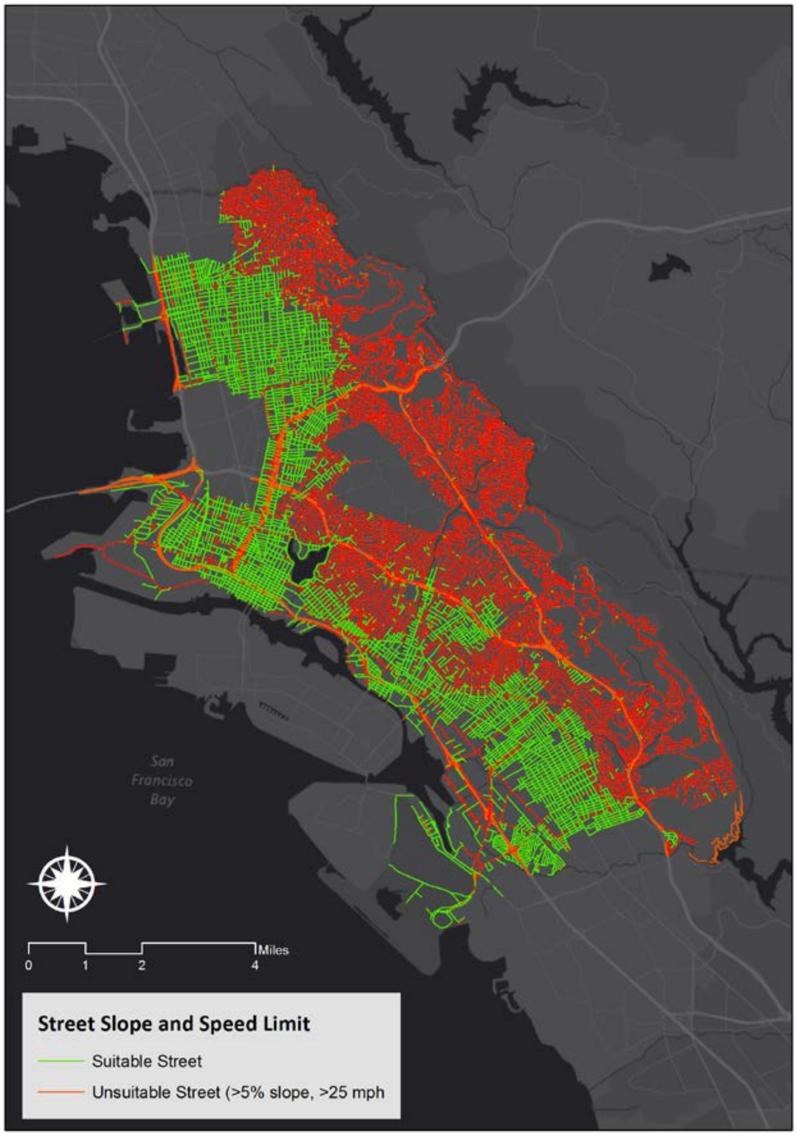


Street Speed Limit

For safety purposes, most parklet design guidelines limit parklet installation to streets with speed limits of 25 miles per hour or less (San Francisco Parklet Manual, 2015) (Anastasia Loukaitou-Sideris M. B., 2012). While some guidelines are less strict, this analysis uses the 25-mile per hour (mph) threshold to apply the strictest standards in the field and to minimize the possibility of a fatal accident, which is far more likely to occur on high-speed streets (Hendel, 2012).

In Berkeley, there are almost no streets with speed limits over 25 mph. Berkeley has a citywide de facto 25 mph speed limit (Speed Limits, 2015). Thus, out of the hundreds of streets in Berkeley, there are only seven street segments with speed limits above 25 mph. In contrast, the City of Oakland has several streets with speed limits above 25 mph. According to the city's municipal code, there are 105 street segments with a 30 mph speed limit, 36 with a 35 mph speed limit, two with a 40 mph speed limit, and one with a 45 mph speed limit (Oakland, California - Code of Ordinance, 2015). It is important to note that these are street *segments*, not entire streets. It is also helpful to know that there are 11,730 total street segments throughout Oakland. In looking at the map, streets with speed limits over 25 mph appear to generally be clustered in both West Oakland and South Oakland (see Figure 9).

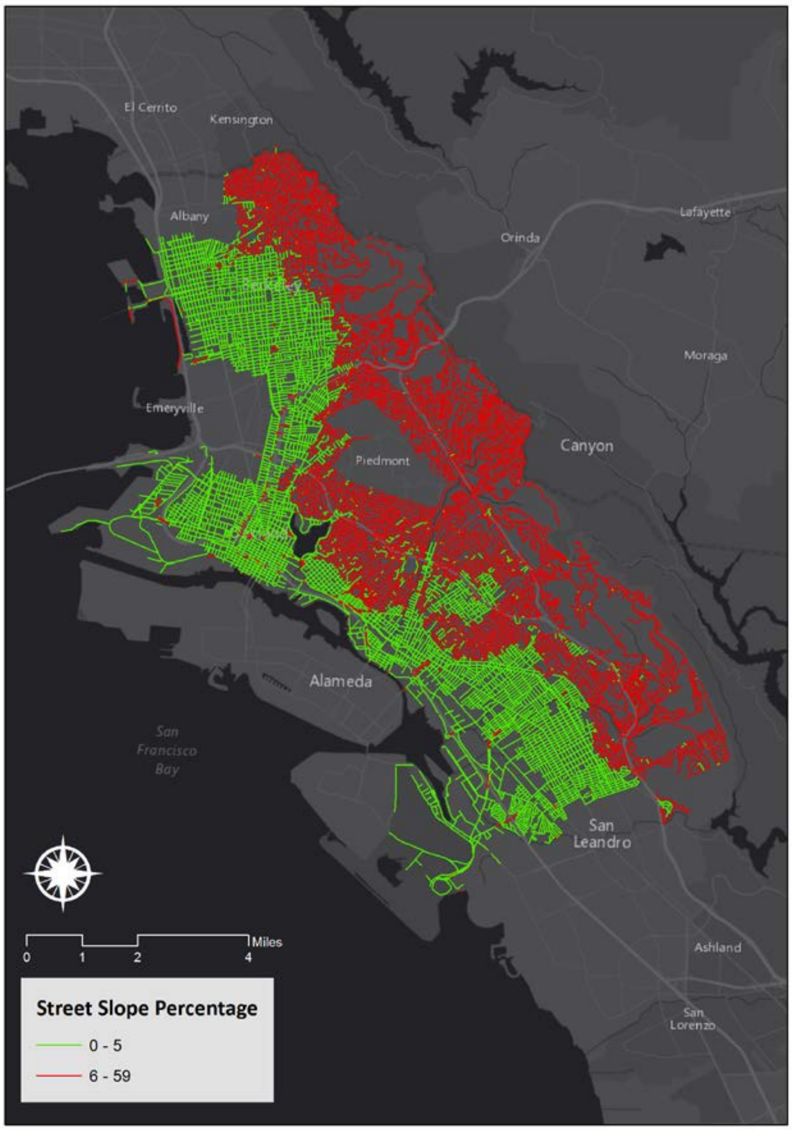
Figure 9: Street Speed Limits and Slopes in Oakland and Berkeley



Street Slope

For accessibility reasons, parklet manuals require that parklets not be built on streets with steep slopes. While several guidelines including Oakland's decline to stipulate a specific percent limit, the San Francisco Parklet Manual restricts parklets to streets with slopes less than or equal to five percent (San Francisco Parklet Manual, 2015). Because many cities including Berkeley (Livable Berkeley: Parklets) use San Francisco's parklet manual as their own, this project's suitability analysis uses the same criteria. The map of Berkeley and Oakland streets featured below illustrates the streets of Oakland and Berkeley with a slope of five percent or less in green and those with a slope over five percent in red (see Figure 10). Unlike cities with hills that dot the landscape, like San Francisco and Seattle, there is a clear delineation in Oakland and Berkeley between the western, flat part of the region and the eastern, hilly part. Notably, the street slopes appear to correlate with median household income, which is addressed in a later section.

Figure 10: Street Slopes in Oakland and Berkeley



Potential Stoplet Locations

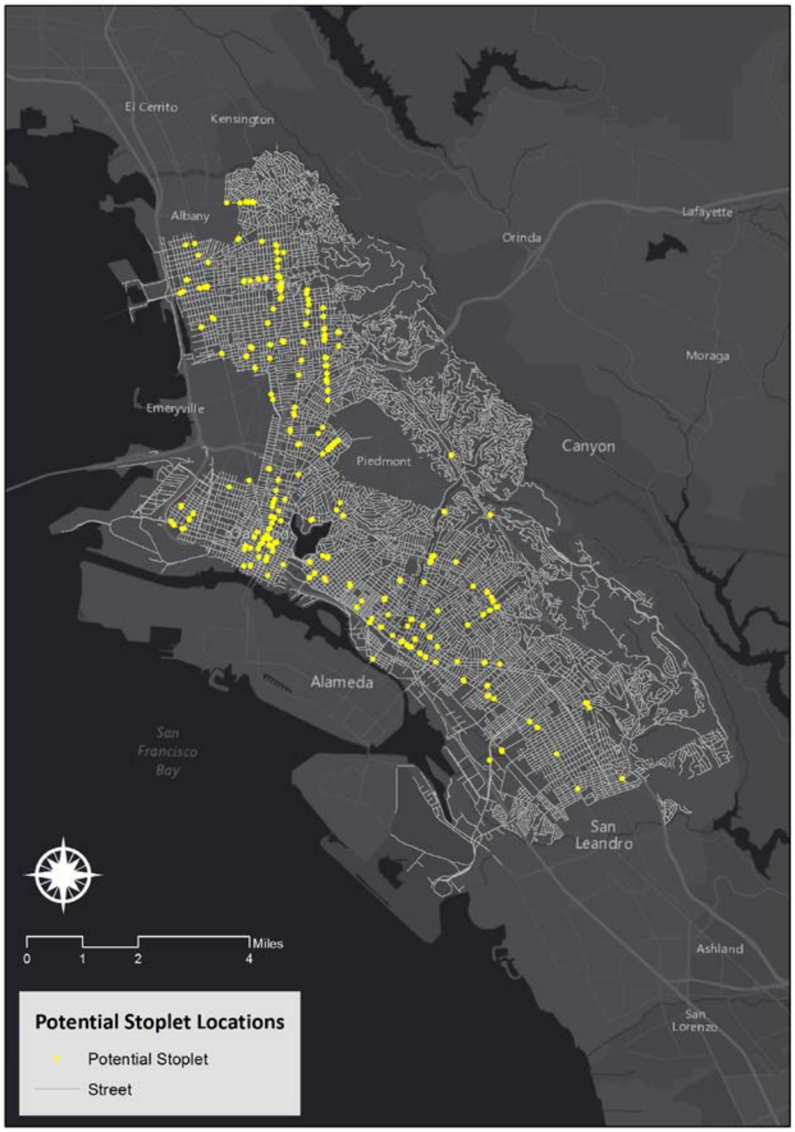
After mapping all of the aforementioned data, I consolidated their individual parameters to determine where in the cities of Berkeley and Oakland stoplets could feasibly be installed. First, I filtered out all bus stops that were not within 100 feet of a retail business. As mentioned in Chapter Three, I maintained such a large buffer to account for slight inaccuracies in the geolocation data of the retail businesses and bus stops. I then filtered out all of the remaining bus stops that were on streets with a speed limit of over 25 miles per hour. Finally, I filtered out the remaining bus stops located on streets with slope percentages of more than five percent. I was left with a map of 295 bus stops that would be suitable for a stoplet installation (see Figure 11).

The map of potential stoplet locations generally reflected the patterns seen in the bus stop map, only with fewer stops. There were large clusters of potential stoplet locations in both cities' downtowns, and several corridors that exposed long trails of potential locations. These corridors included Broadway, College Avenue, Foothill Boulevard, International Boulevard, MacArthur Boulevard, Telegraph Avenue, Shattuck Avenue, and University Avenue (see Table 28).

Table 28: Streets with Highest Number of Potential Stoplets

Street Name	Number of Potential Stoplets Along Street
International Blvd	25
Telegraph Ave	21
College Ave	19
Broadway	18
University Ave	18
Shattuck Ave	15
Foothill Blvd	12
MacArthur Blvd	11

Figure 11: Potential Stoplet Locations in Oakland and Berkeley



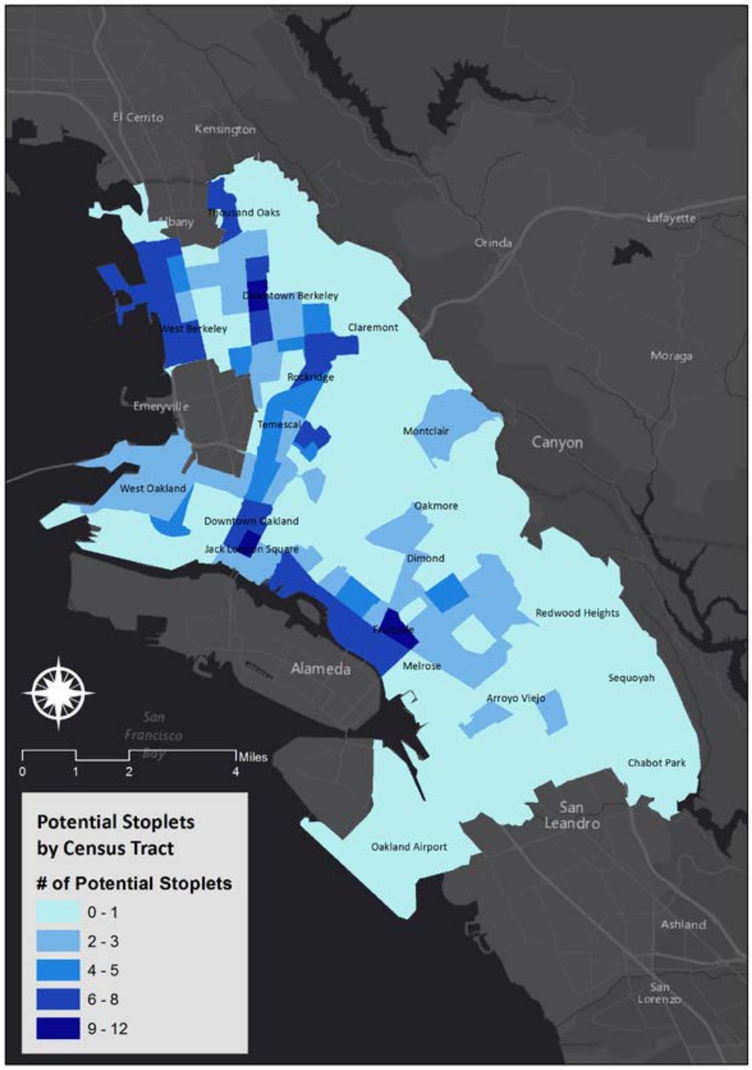
STOPLET SUITABILITY INDEX

After determining which bus stops in Berkeley and Oakland were "stoplet feasible," I then began to construct the stoplet suitability index. The index combines three factors – number of feasible stoplet locations, percent park space, and median household income – and observes them at a census tract level to identify the areas of the two cities most deserving of stoplets.

Stoplet Locations by Census Tract

The first dataset I incorporated into the suitability index was the number of stoplet locations per census tract. After creating the map of potential stoplet locations, I looked at how evenly these locations were distributed throughout Oakland and Berkeley. The number of potential stoplets in Oakland and Berkeley ranged from zero locations per census tract to twelve. In looking at the map, there are many more stoplet opportunities on the western side of the two cities than on the eastern side. This is primarily due to the region's geography, discussed in the *Street Slopes* section above. The highest number of opportunities appears to be around Downtown Berkeley, northwest Berkeley near the Berkeley Marina, and in the Clinton and Fruitvale neighborhoods of Oakland (see Figure 12).

Figure 12: Potential Number of Stoplets by Census Tract

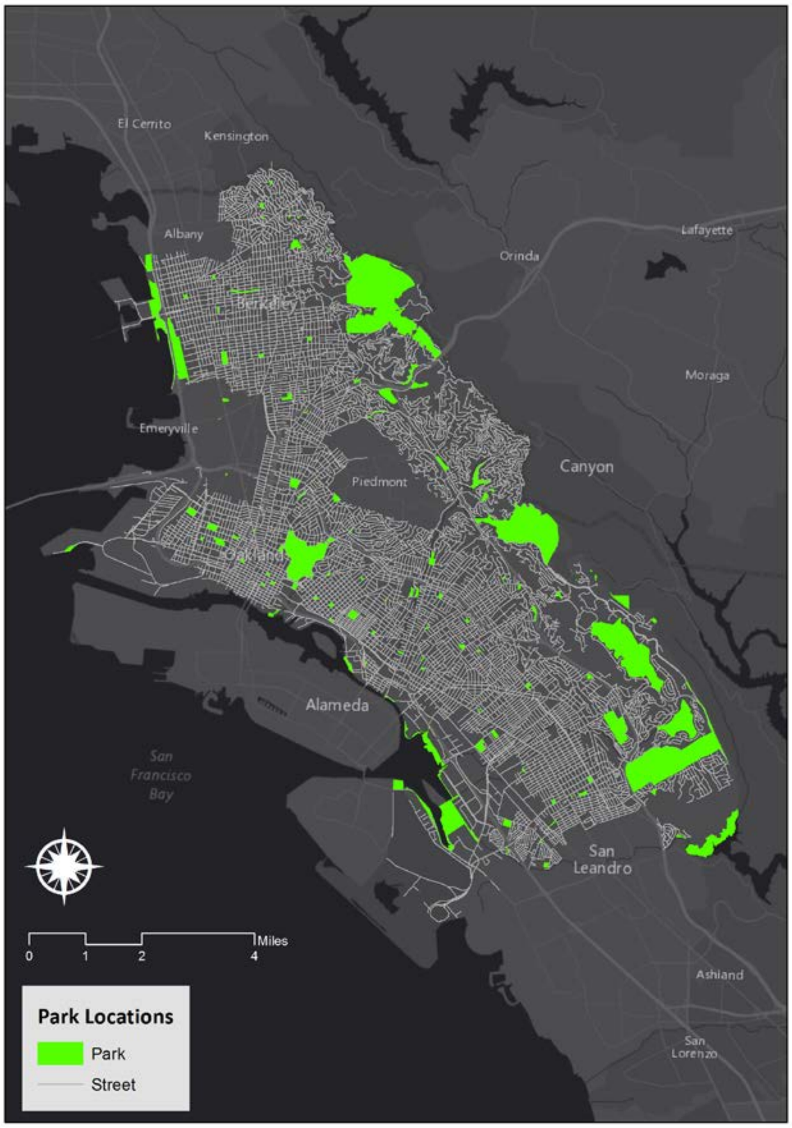


Percent Park Space by Census Tract

The second factor I incorporated into the suitability index was the amount of existing park space in each census tract. As discussed in Chapter Two, public space is important for cities because it provides social, economic and safety benefits for its residents. It can improve happiness (Kellert, 1995), foment racial, ethnic, and socioeconomic integration (Shaftoe, 2008), and enhance public safety (Clarke, 1998). And it is particularly important to low-income communities that lack sufficient private space of their own (Walljasper, 2012).

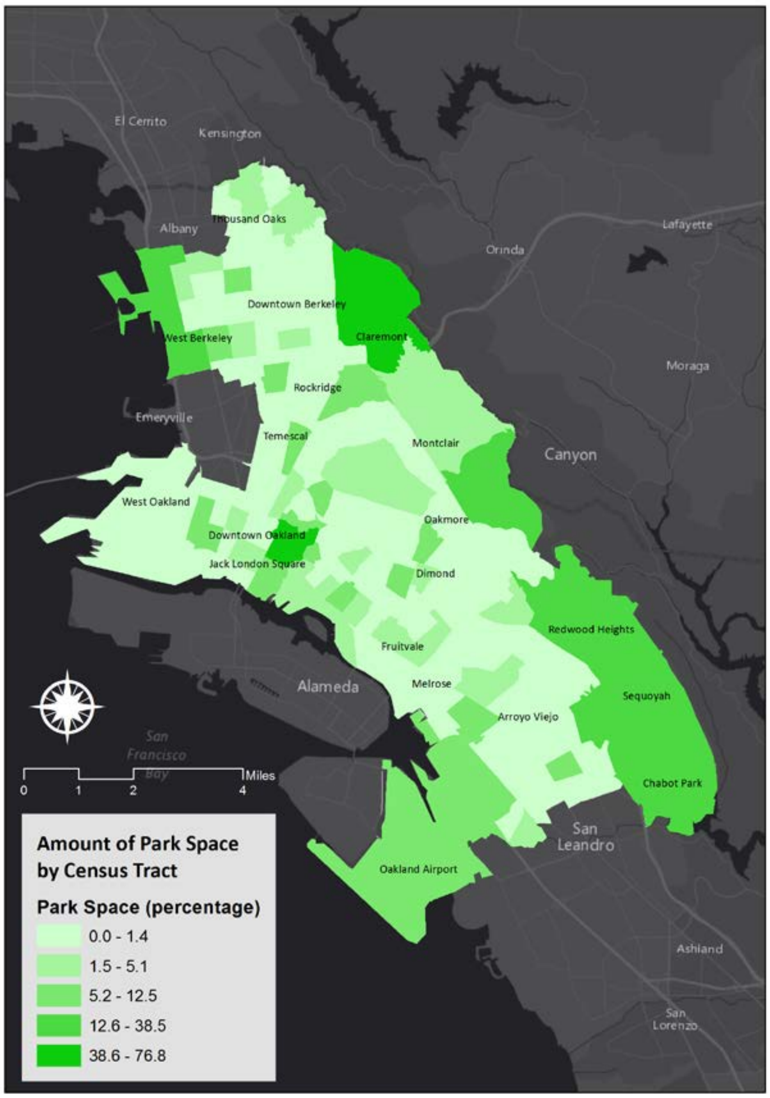
There are 117 parks throughout Oakland and Berkeley. While this number appears high, a closer look reveals a large disparity in the number of parks and amount of park space in each community (see Figure 13). By looking at the percentage of park space per census tract, it is easy to see which parts of Berkeley and Oakland have an overabundance of park space, and which areas have a dearth (see Figure 14).

Figure 13: Public Park Locations in Oakland and Berkeley



While stoplets are by no means a sufficient substitute for public parks, they can nonetheless provide a number of public amenities that are sorely lacking throughout many Oakland and Berkeley communities. In looking at the map, it is clear how many communities are lacking sufficient public space and how large the disparity is between communities. Out of the 163 census tracts observed, 110 have less than 1.8% of their land designated as park space, while 64 tracts have no park space at all. Meanwhile, a single tract in the Oakland hills is comprised of 76.8% park land. By encouraging stoplets in some of Oakland and Berkeley's most park-poor areas, these cities can begin to slowly transition toward a more equitable allocation of public space.

Figure 14: Percent Park Space per Census Tract in Oakland and Berkeley

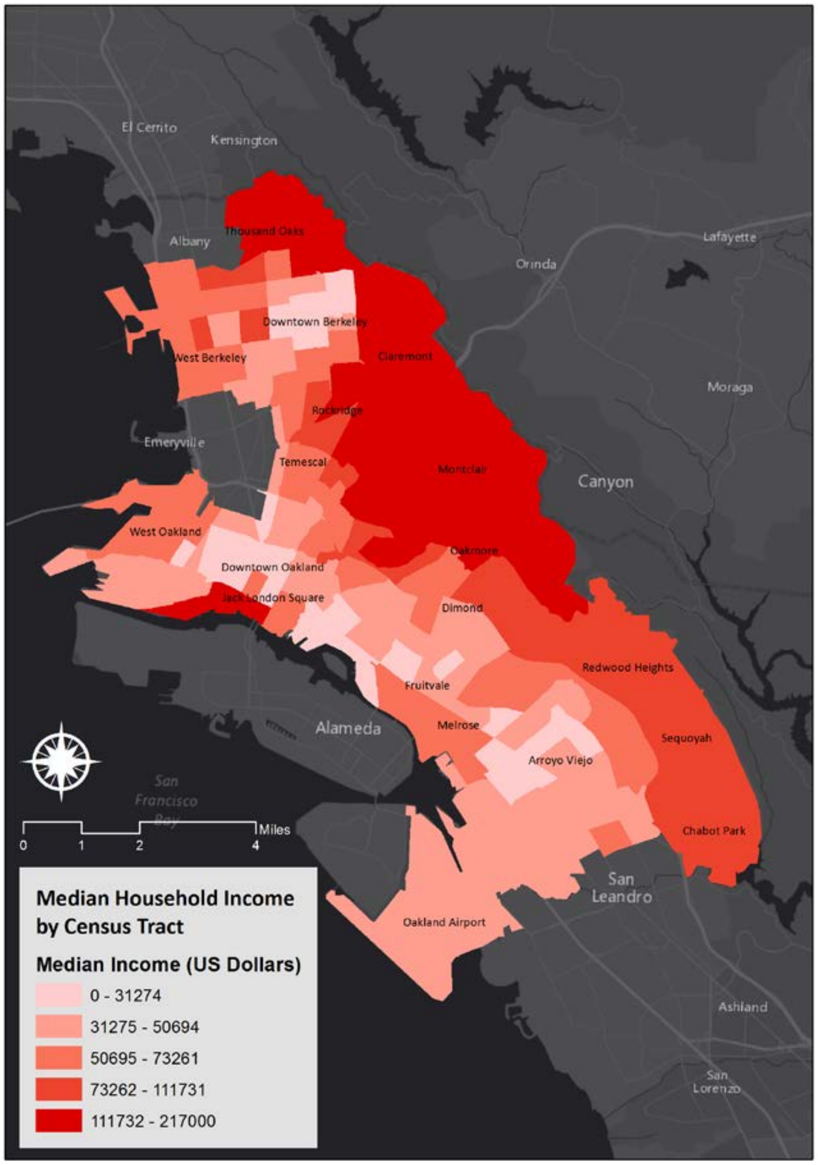


Median Household Income by Census Tract

There is a wide range of incomes in Oakland and Berkeley, with census tracts' median household income ranging from $16,680 in part of West Oakland to $185,000 in Oakland's Lake Shore neighborhood (the census tract on the map with the highest median income of $217,000 is in Piedmont, a city within Oakland's borders, but not technically part of Oakland). Because low-income communities generally have fewer public amenities and more transit-dependent residents than other communities (White, 2015), stoplets present cities with a low-cost opportunity to bring high-quality bus stops and public spaces to these underserved areas. Stoplets also provide cities with an opportunity to bring parklet-like treatments to communities where parklets don't currently exist because neighborhood businesses are unable to afford the upfront costs necessary to construct them (Agyeman, 2014).

The map below illustrates the spatial mismatch of rich and poor communities in Oakland and Berkeley (see Figure 15). Many of the two cities' low-income pockets also tend to be located in some of the most park-poor parts of town, and in the flat areas versus the hills. While there is a great deal of information to interpret in these maps and their associated data, there are even more inferences and insights to glean from a map that combines these data into a single index.

Figure 15: Median Household Income by Census Tract in Oakland and Berkeley



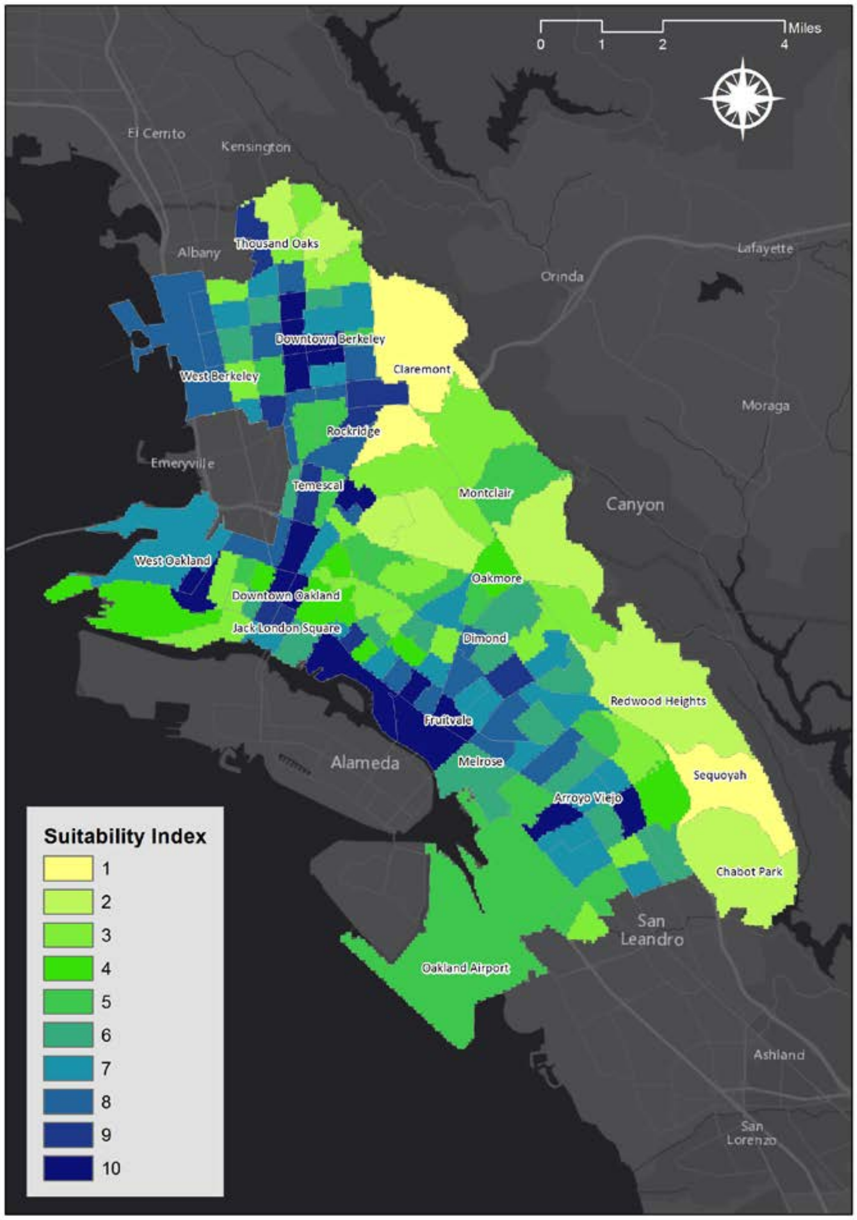
The Stoplet Suitability Index

The Stoplet Suitability Index incorporates the three aforementioned sets of data into a single map to illustrate which census tracts in Oakland and Berkeley should be prioritized for stoplet implementation. To create the Index, I first broke each of the three factors (median household income, percent park space, number of potential stoplet locations) up into quantiles, creating equally sized data subsets in the five ranges displayed in the legend of each map. I then reassigned values to each of these ranges, so that they could be easily consolidated into one map. For instance, I assigned a "1" to census tracts with between 0-1 potential stoplet locations, a "2" to census tracts with between 2-4 stoplet locations, a "3" to census tracts with between 5-7 stoplet locations, and so on. For both percent park space and median household income, I assigned numbers one through five to each quantile in reverse order, so as to give more points to the most park-deficient and lowest-income parts of town. Thus, the census tract with the highest number of potential stoplet locations in the lowest-income census tract with no park space receives the highest possible ranking in the index.

I then went on to weight these values, giving potential stoplet locations twice the weight of percent parks and median income. This was done to further prioritize areas with a high number of potential stoplet locations, as stoplet feasibility is the most important factor in deciding where stoplets can and should be located. Finally, with the newly assigned values and weights, I created a map that assigned a value of 1-10 to each census tract in Oakland and Berkeley. Thus, the Stoplet Suitability Index was born. Based on the Index, census tracts assigned a value of 10 are the highest priority tracts for stoplet implementation, while those assigned a 1 are the lowest priority tracts.

The Stoplet Suitability Index ranks seventeen census tracts as having the highest possible priority for stoplets (see Figure 16). These census tracts include parts of Downtown Berkeley, Downtown Oakland, South Berkeley, West Oakland, Arroyo Viejo (Oakland), Castlemont (Oakland), Elmwood (Berkeley), Fruitvale (Oakland), Hoover-Foster (Oakland), Piedmont Ave (Oakland), San Antonio (Oakland), and Southside (Berkeley) (for details of these areas, see Appendix). These tracts are fairly evenly distributed throughout the flat areas of Oakland and Berkeley and, unsurprisingly, cover areas that reflect moderate incomes, a high number of transit routes, and a high density of commercial retail locations. When Alameda County's stoplet program gets on the ground, the managing agency is encouraged to utilize this map, or to create a similar map comprised of relevant data in order to help determine which areas should be prioritized for stoplet implementation.

Figure 16: Stoplet Suitability by Census Tract in Oakland and Berkeley



Discussion and Recommendations

Based on the findings of the meta- and suitability analyses, this chapter explores the many benefits and challenges that may arise from the implementation of an official stoplet program. These opportunities and challenges inform the recommendations that follow. While this paper's list of recommendations is by no means an authoritative strategy for how to successfully implement such a program, it nonetheless provides a framework for AC Transit to build upon if and when it launches its official stoplet program in Alameda County.

OPPORTUNITIES

Accessibility

Many existing bus stops pose significant challenges to people with disabilities. AC Transit's own data indicate that only 58% of their 5,533 bus stops are ADA compliant (Bus Bench Analysis, Filtered Routes, 2014). Transit agencies around the country do not fare any better. A 2013 survey of 84 transit agencies throughout the US found that over 30% of agencies had more non-ADA compliant bus stops than they had compliant stops (Suksawang, 2013). This is in addition to the 19% of respondents who were unsure about the ADA-compliancy of their bus stops.

Under the American with Disabilities Act of 1990, transit agencies are required to develop a plan for retrofitting bus stops so that they are in compliance with the law (Turner, 2008). But despite this mandate, transit agencies continue to struggle to fund their ADA accessibility plans (Equity in Transportation for People with Disabilities).

A collaborative effort between the transit agency and local businesses to build ADA-compliant stoplets could re-energize the agency's compliance effort, create a cheaper alternative to costly bus bulb outs, and split the cost burden between the agency and business, thereby bringing the cost down even further.

Comfort

Currently, benches are only located at 40% of AC Transit bus stops, while shelters are located at fewer than 20% of existing stops (Bus Bench Analysis, Filtered Routes, 2014). Even at the most extravagant of bus stops in the AC Transit network, there is only enough seating for three or four people. This is despite the fact that several stops throughout the system boast daily boarding numbers of upwards of 500 people (Bus Bench Analysis, Filtered Routes, 2014).

The stoplet program will increase the amount of seating at each bus stop location by providing both permanent and temporary seating to transit riders, business patrons, and neighborhood residents alike. Additionally, each stoplet will provide shelter, lighting, landscaping, and other amenities, collectively making for an enjoyable experience while waiting for the bus.

In previous research on bus stops and parklets, users have expressed comparatively more enthusiasm about parklets (Anastasia Loukaitou-Sideris M. B., 2013) than bus stops (Taylor, 2008). By designing bus stops in a similar fashion to parklets, transit agencies have the opportunity to turn the obligatory bus waiting experience into a more comfortable, enjoyable, and relaxing experience.

Cost

According to AC Transit's own estimates, bus bulbs cost around $633,000 to construct, including amenities (AC Transit East Bay Bus Rapid Transit Project, 2012). By comparison, parklets cost only between $11,000-$25,000 (Anastasia Loukaitou-Sideris M. B., 2013), even before taking into account the potential shared cost between a bus stop-adjacent small businesses and the transit agency. By these numbers, transit agencies would be able to construct between 25 – 58 stoplets for the price of one bus bulb.

Equity

While there are countless examples of bus and rail stops and stations that lack sufficient passenger amenities, heavy and light rail stations generally have comparatively more seating, lighting, and shelter than their bus stop counterparts. As a higher percentage of low-income individuals ride the bus rather than the train (A Profile of Public Transportation Passenger Demographics and Travel Characteristics Reported in On-Board Surveys, 2007), this discrepancy reflects an inequitable allocation of resources.

Additionally, parklets tend to be built in higher-income neighborhoods (Stroman, 2014), outside of businesses that are wealthy enough to afford the structure's upfront costs. By creating a stoplet program in which a business can share the cost burden with the local transit agency, cities can simultaneously improve bus stop conditions and bring parklet-like spaces to their underserved communities.

Economic Development

Parklets encourage pedestrian activity on commercial corridors, which in turn leads to more revenue for local businesses (Lesley Bain, 2012). By creating more sidewalk space, parklets improve pedestrian flow, which allows people to do more shopping in the same amount of time (The Economic Benefits of Sustainable Streets, 2011). And by providing an attractive space for people to gather, parklets lure in passers-by and give customers an excuse to linger around a business and shop longer (Pratt, Parklet Impact Study, 2011). All of this amounts to a 20% average increase in revenue for businesses with parklets, according to one study out of Philadelphia (The Case for Parklets, 2011). A stoplet would function in much the same way, and should therefore be similarly recognized as a local economic development tool in addition to a means of improving the bus stop waiting experience.

Efficiency

By extending the bus stop to the edge of the parking lane, one oft-cited study found that bus bulbs increased average bus speeds between 7%-8%, increased average vehicle speeds between 17%-46%, and increased average pedestrian flows 11% (Kay Fitzpatrick, 2001). Thus, agencies can significantly improve ease of travel for public transit, pedestrians, *and* private vehicles with every stoplet installed along city streets.

Public-Private Partnership

Transit shelters are strongly opposed by merchants in some communities, as they can block store windows, impede pedestrian traffic, and are often criticized for their unsightly design (Hilkevitch, 2002). In contrast, parklets are in high demand, with some merchants waiting months for the opportunity to spend tens of thousands of dollars to repurpose prime on-street parking outside of their business (Cowen, 2014).

By creating a partnership between the merchant and transit agency in which a storeowner applies for a stoplet and plays an active role in the design of the space, transit agencies have the opportunity to shift the paradigm on bus stops. By demonstrating their economic value and emphasizing the link between transit accessibility and higher revenue, bus stops can begin to be seen as a blessing rather than a curse for local businesses.

Safety

A 2003 study found that a 100% increase in pedestrian traffic led to a 66% reduction in the pedestrian injury rate in the same area (Jacobsen, 2003). A separate study found that when parklets were installed in three neighborhoods around San Francisco, pedestrian traffic along the blocks on which they were installed increased up to 44% (Pratt, Parklet Impact Study, 2011). Finally, a parklet customer satisfaction survey found that parklets' role in protecting pedestrians from passing vehicles was the highest rated benefit among all survey takers (Ocubillo, 2014).

Meanwhile, in a study on the safety impact of bus bulbs, researchers found a 64% decrease in the number of passengers who had to step into the street to board and alight the bus. And in a study on perceptions of bus stop safety features, 81% of bus passengers and 72% of bus operators rated bus bulb outs as either a good or very good type of safety improvement (more than any other feature) (Johnson, 2005).

Thus, stoplets have the potential to improve both real and perceived pedestrian and bus passenger safety by increasing the amount of foot traffic in the area, creating a space for passengers to seamlessly board and alight the bus from the sidewalk, and generally creating a safer-feeling environment.

Security

Research shows that more eyes on the street lead to less criminal activity. In a study on bus stop crime in Los Angeles, researchers found that off-bus crime was less common among large crowds of people, indicating that even at late hours, bus stop crimes could be prevented through the mere presence of others (Levine, Wachs, & Shirazi, 1986). As mentioned in the above section, parklets have increased pedestrian traffic in San Francisco by up to 44%, with that figure increasing to 100% on evening weekends (Pratt, Parklet Impact Study, 2011). A separate study on bus stop crime found that crime was significantly lower at bus stops that had good lighting, good visibility, and the presence of bus shelters (Loukaitou-sideris, 2007).

Because the stoplet program would focus on bus zones outside of businesses, safety issues are primarily addressed through the tenets of crime prevention through environmental design. Specifically, stoplets will encourage more eyes on the street by creating an activated pedestrian space, and bring visibility and shelter to currently neglected bus stops. These amenities will not only make for a more enjoyable waiting experience, but based on the aforementioned research, they will make the experience empirically safer from criminal activity as well.

CHALLENGES

Accessibility

Accessibility for users with disabilities is a necessary consideration of any bus stop improvement program. While street furniture can improve the bus stop waiting experience for the vast majority of users, it can also create additional obstacles for transit riders with disabilities. In order to mitigate any potential accessibility issues, stoplet program managers should work closely with the disabled community to ensure that changes to the bus stop do not simultaneously hinder access for people with disabilities.

Cost

While the initial capital cost of a typical parklet is significantly lower than that of a standard bus bulb out, there are other financial factors to consider. Additional stoplet costs may arise from the stoplet's length, life cycle, and damage incurred from bus collisions. Parklets are typically two parking spaces long (around 40 feet) (Arnett) while the average length of a bus bulb in some cities can be 140 feet, so current cost estimates may not paint the full picture (Kay Fitzpatrick, 2001). In terms of life expectancy, the typical life span of a concrete sidewalk is around 80 years (A Guide for Maintaining Pedestrian Facilities for Enhanced Safety, 2013) , while a parklet's typical life span is uncertain due to varying materials and the fact that the concept has only been around for five years. Finally, due to stoplets' abundance of street furniture, they are far more likely to be damaged if a bus accidentally jumps the curb. Stoplet program coordinators should be extra cautious to ensure that stoplet furniture is both durable and a sufficient distance from the curb, and that the structure is adequately insured.

A second challenge related to cost is who will pay for stoplet amenities, energy, and insurance. Amenities such as lighting, signage, and real-time information can be costly and require a continuous power source. These concerns must be adequately addressed before any such program is implemented.

Efficiency

While studies have shown bus bulbs to significantly improve bus, pedestrian, and private vehicle travel times (Kay Fitzpatrick, 2001), it is likely that stoplets will function slightly differently. By creating an inviting environment for people to sit and relax, stoplets may create an element of ambiguity surrounding who is waiting for the bus and who is merely enjoying the space. If the bus is designed as a flag stop (a stop where passengers are expected to wave the bus down when they want to board), someone sitting at the stop with no intention of taking the bus may nonetheless prompt the bus operator to stop, thereby needlessly increasing the travel time of everyone on board.   This challenge can be mitigated by either limiting stoplets to stops that operators are prohibited from passing over, or by requiring that all stoplets include an illuminated signpost with a built-in bus signal (i-STOP Solar-Powered LED Illuminated Transit Stop, 2006), an amenity slowly gaining popularity among transit agencies across the country.

Public-Private Partnership

The stoplet concept is intended to be a partnership between a city or regional transit agency and a local business, non-profit, library, school, or other active land use. Through this partnership, the two entities can work collaboratively to bring attractive design, practical amenities, and positive human activity to a heavily frequented but oft forgotten urban space. While this partnership makes practical sense, it may be logistically infeasible in some cities on account of the existing partnership between the transit agency and the bus shelter contractor. The bus shelter advertising contract (BSAC) is a concept that has become increasingly popular in US cities over the past few decades, as it results in the construction and maintenance of sometimes thousands of new bus stop shelters in exchange for the exclusive rights to the shelter advertising space (DePriest, 2014). While at first glance, this is a huge bargain for the transit agency, it also establishes a gray area when that agency pursues the modification of a bus stop space, an issue that is likely to emerge during the implementation of a stoplet program.

A second challenge with the public-private nature of the space that is also addressed in the Cost section is the question of who is responsible for the initial cost and ongoing maintenance of stoplet amenities, energy, and insurance. If an agreement between the public and private entity is not established before the program is implemented, this question has the potential to become contentious down the road.

Safety

Safety is perhaps the greatest challenge of any future stoplet program. Several parklet design guidelines contain safety standards that if adopted, would render any stoplet program unworkable. These standards include the prohibition of parklets at street corners (San Francisco Parklet Manual, 2015), a required contiguous barrier along the parklet's outer edge (Parklet Program Pilot Extension, 2014), and a mandatory impervious platform (Guidelines for the Location and Design of Bus Stops, 1996), which could significantly increase the stoplet's cost by limiting the type of material used.

The consistently close interaction between the stoplet and bus will likely require additional safety precautions that may present new, unforeseen challenges. There are several possible strategies to mitigate bus-stoplet collisions, but their effectiveness will only be confirmed once an actual stoplet is finally constructed and these ideas are assessed empirically.

Security

By increasing the amount of street furniture at a given bus stop, stoplets will consequently provide people and packages with additional places to hide. This can potentially cause a security concern for individuals waiting at the bus stop. Such issues can be mitigated by constructing the stoplet next to an active land use and providing sufficient lighting and appropriate shelter design (Loukaitou-sideris, 2007), but should be seriously considered during the stoplet's design phase.

RECOMMENDATIONS

While there are several challenges that should be considered before embarking on a full-fledged countywide stoplet program, there are countless benefits to the stoplet concept that far outweigh the barriers to implementation. AC Transit should thus pursue the implementation of this concept on a case-by-case basis, applying the lessons from each pilot project to a comprehensive set of guidelines for future projects. Below is an initial set of recommendations for stoplet guidelines that incorporates instructions from the existing literature on bus stop and parklet location and design, as well as the challenges addressed in the section above. This set of recommendations is by no means a definitive list, but rather a starting point on which to build as individual projects are implemented and additional challenges are identified. The guidelines outlined in this section are broken down into 13 sections, reflective of the sections in this paper's meta-analysis. Information is conveyed in three styles in an effort to communicate with a diverse audience. These styles include 1) annotated paragraphs, 2) a simplified chart, and 3) several illustrative renderings.

Accessibility

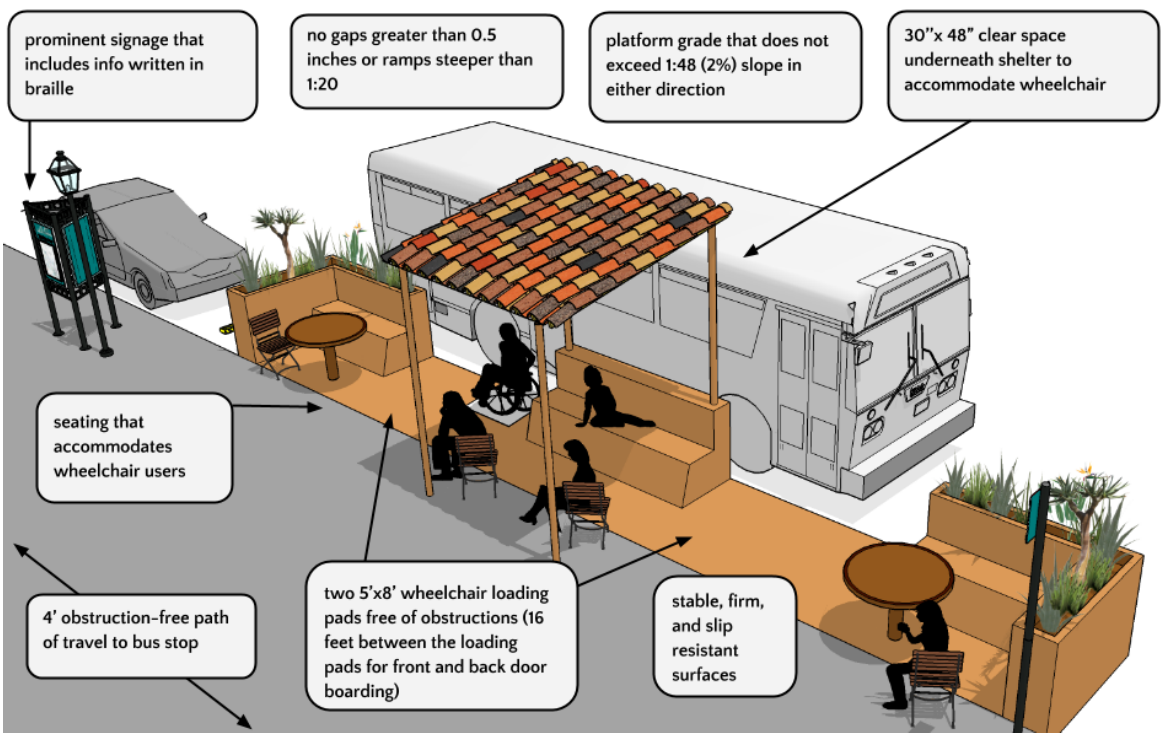
The stoplet should have two wheelchair landing pads to allow for wheelchairs to board and alight from both the front and back doors of the bus. These pads should be at least five feet wide and eight feet long and there should be a distance of exactly 16 feet from one pad to the other to account for the distance between the bus's two front sets of doors.

All seating, tables, and shelters should be arranged in such a way that accommodates wheelchair use. If the stoplet contains a shelter, there should be a 30-inch by 48-inch clear space underneath the shelter to accommodate a wheelchair. There should also be a four-foot wide obstruction-free path of travel to each of the stoplet's wheelchair landing pads.

The platform of the stoplet should be made of stable, firm and slip resistant material. There should be a maximum gap of 0.5 inches between the stoplet and the sidewalk, and between all individual components of the platform. Any ramp on the stoplet should be no steeper than 1:20 (or a 5% slope), while the slope of the stoplet itself should not exceed 1:48 (or a 2% slope) in either direction.

Signage should also accommodate users with disabilities. All signage should be prominently displayed in large font and include braille translation (see Figure 17).

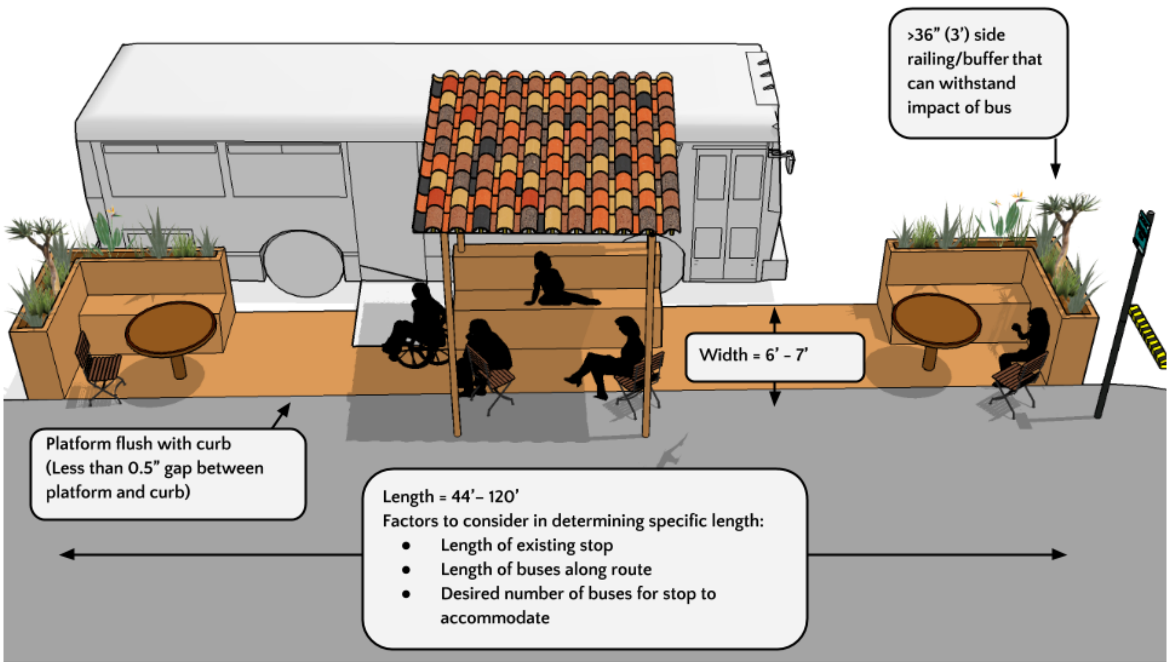
Figure 17: Stoplet Rendering with Accessibility Recommendations



Dimensions

The width of the stoplet should be six to seven feet, while the length will be dependent on several factors, including the length of the existing stop, the length of the buses operating along the route, and the number of buses the stop is anticipated to accommodate at one time. Despite these variables, the stoplet should be no less than 40 feet and no more than 120 feet long. A buffer that spans the width of the stoplet (perpendicular to the street) on either side of the structure should be included in the stoplet's design. This buffer can take the form of a railing, planter, or any other mechanism to delineate the space, as long as it is at least three feet tall (see Figure 18).

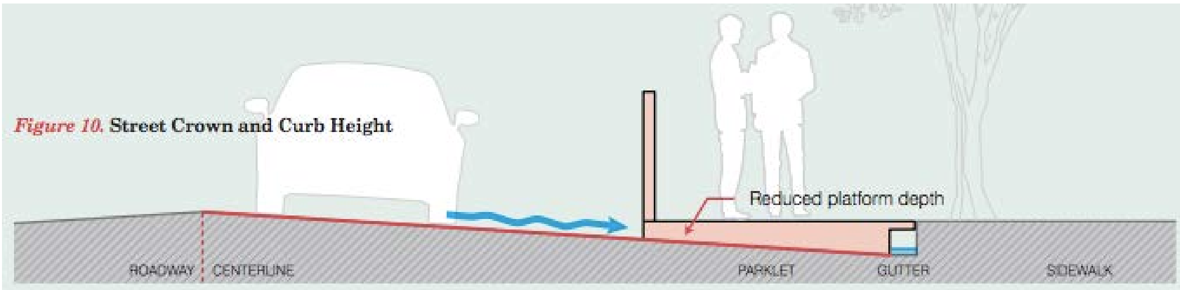
Figure 18: Stoplet Rendering with Recommended Dimensions



Drainage

Any stoplet design should maintain existing drainage along the side of the curb. This can be accomplished by leaving a gap between the structure and curb at the stoplet's base, while ensuring that the stoplet's platform remains flush with the curb (see Figure 19). It is recommended to also cover either end of the drainage gap with a screen so as to prevent the accumulation of debris.

Figure 19: Example of a Parklet Drainage System

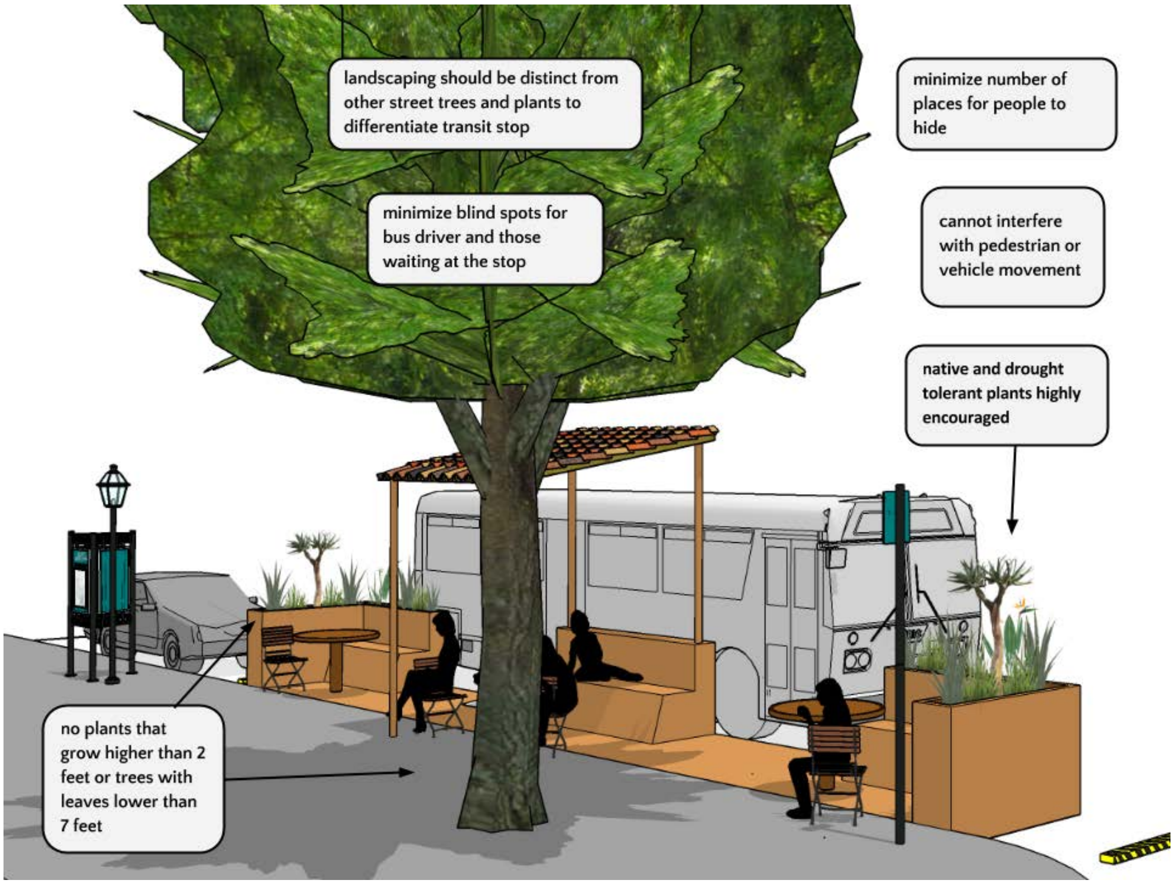


(San Francisco Parklet Manual, 2015)

Landscaping

Landscaping should be included in stoplet design in such a way that does not obstruct views or create potential safety or security threats. In particular, plants should not grow higher than two feet tall and tree foliage should grow no lower than seven feet. Additionally, landscaping should not interfere with pedestrian or vehicle movement, provide places for people to hide, or create blind spots in the sight lines of the bus operator or those waiting for the bus. Finally, all stoplet plants and trees should be native, drought tolerant, and distinct from other trees and plants along the street to differentiate the space from other parts of the sidewalk (see Figure 20).

Figure 20: Stoplet Rendering with Landscaping Recommendations



Lighting

Stoplet lighting should be bright, but not so bright that it creates glare. It should be made to illuminate both the shelter and the adjacent bus signage. The light casing should be made of durable, shatterproof material and the bulb should be energy efficient and autonomously powered, if possible. Lighting should remain on throughout evening bus service hours to help deter bus stop crime. If there is an existing street lamp next to the stoplet that meets the aforementioned criteria, that light is a sufficient substitute.

Materials

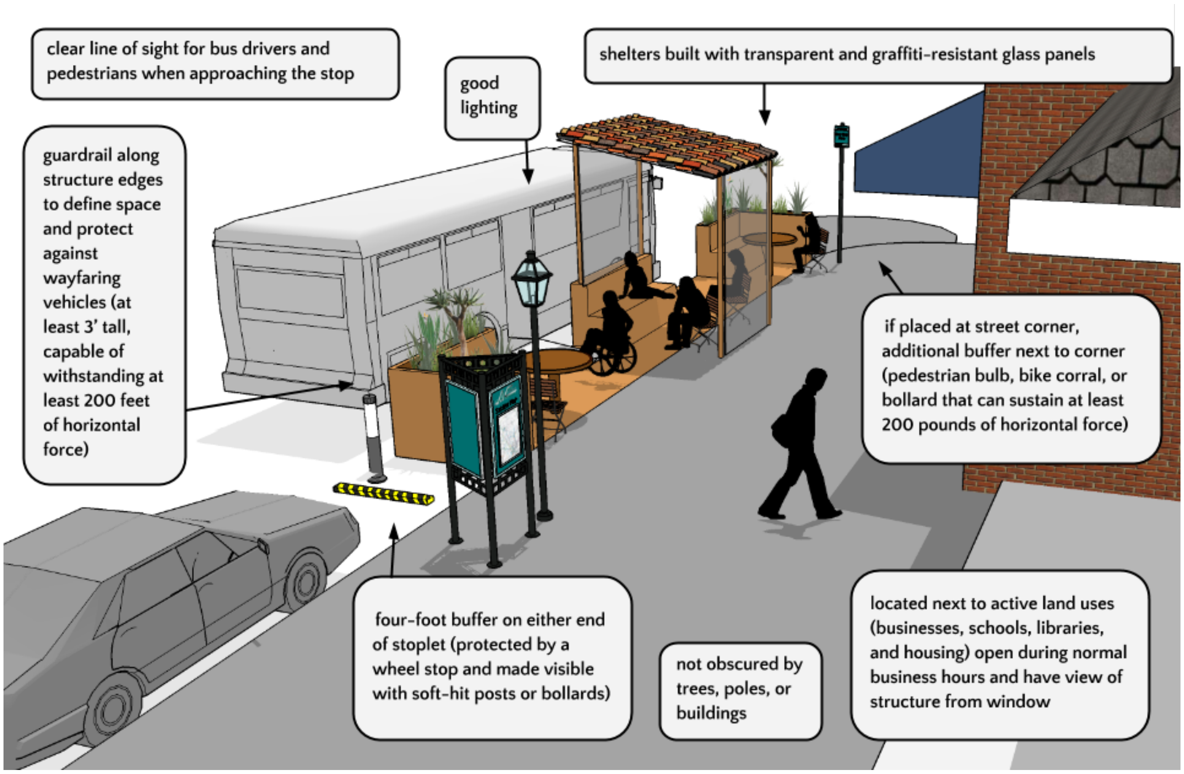
The materials used to construct the stoplet should be durable, high quality, slip-resistant, easily maintained, and aesthetically pleasing. There are two acceptable approaches to constructing the base of the stoplet. The first is by pouring concrete over a plastic slip-sheet to keep the base from binding to the roadway. If this method is used, the concrete should not contain any rebar nor should it weigh less than 200 pound per square foot. The second method is to build a separate platform and sub-structure and nail or screw the two together. If this second method is used, it is recommended that the platform be made of either wood or steel. The substructure can be made of any number of materials as long as it is designed to sustain at least 100 pounds per square foot. The substructure should also be easily accessible for maintenance and all parts of the stoplet base should be easily removable in case they are damaged or defaced. Finally, it is recommended that the substructure incorporate a Bison pedestal system into its design to ensure stoplet stability. Regardless of what materials are used for the base and platform, a concrete curb should be incorporated into the street side of the stoplet to sufficiently buffer the bus from the stoplet and to prevent constant damage to the structure.

Safety Features

To ensure the safety and security of stoplet users, a stoplet should be located next to an active land use such as a business, school, or library that is open during normal business hours or longer. It should also be highly visible from the windows of this establishment, and from the adjacent street and sidewalk so as to provide a clear line of sight for bus drivers and pedestrians approaching the stop. Lighting should be bright and pervasive, and the stoplet should be designed in such a way that minimizes potential hiding spaces. If the stoplet's shelter is built with side panels, these panels should be built with transparent, graffiti-resistant glass.

In terms of safety features, there should be a four-foot buffer at either end of the stoplet, physically protecting the space with a wheel stop and made visible with either soft-hit posts or bollards. There should be a guardrail, planter box, or other protective structure along the sides of the stoplet perpendicular to the sidewalk, which should be at least three feet tall and capable of withstanding at least 200 feet of horizontal force. If placed at the street corner, an additional buffer such as a pedestrian bulb, bike corral, or bollard that can sustain at least 200 pounds of horizontal force should be installed (see Figure 21).

Figure 21: Stoplet Rendering with Recommended Safety Features



Seating

Seating placement should allow for a clear path of travel to the stoplet and should not impede pedestrian flow along the sidewalk or obstruct designated wheelchair areas on the structure. If a shelter exists, it should contain permanent seating underneath it, and if not seating should be placed in an area that is shaded, well-lit and sufficiently protected from the elements whenever possible.

There should be enough permanent seating (seating built into the structure) for three people to sit at any given time, and all seating should have arms to both assist the elderly and deter people from sleeping. Any seating facing the street should be kept at least two feet from the curb.

The stoplet should have a mix of permanent and portable seating that is owned and maintained by the adjacent land use. The stoplet's portable seating should be light, durable, easy to move, and weather-, graffiti-, and fire-resistant, and should be left at the stoplet during business hours, if not longer. This seating as well as any portable tables should have a distinct design from the other tables and chairs owned by the adjacent land use to emphasize the public nature of the space.

Shelter

The stoplet shelter should be made out of strong, durable, and easily cleanable materials. It should provide shade during the day and protection from the elements during inclement weather. Its roof should be at least 80 inches from the platform and if it has side panels, they should be transparent so as to allow bus operators and passengers to see inside and out of the space, and to ensure clear views of the adjacent land use.

The shelter should be placed at least two feet from the curb while also not impeding pedestrian traffic. The space should be large enough to accommodate a wheelchair, incorporate seating, be well lit, and contain a map, schedule, emergency phone, and real-time information whenever possible. If a large tree currently exists next to the bus stop that provides sufficient protection from the elements, it can supplement the need for a shelter.

Signage

All signage conveying bus information should be double-sided and reflectorized. At the very least, sign information should include the bus route number and destination, a unique stop identification number, and the transit agency logo. This information should be conveyed in fonts, colors, and images unique to the transit system.

Bus stop information signage should be located as close to the front landing pad as possible without obstructing the path of travel. It should also be located at least two feet away from the curb (or street side edge of the stoplet) and at least eight feet from the stoplet shelter. Finally, if placed on a pole, signage should be posted at least seven feet high and not obstructed by trees, buildings or other signage. Additional signage should be posted at the stoplet indicating that the structure is a public space.

Street Conditions

Stoplets should be installed on streets with speed limits of 25 miles per hour or less, with a slope of 5% or less, and with a cross slope (the street's perpendicular slope) of 2% or less. Priority should be given to projects on streets with low traffic volumes, high pedestrian volumes, narrow sidewalks, and more than one lane in each direction.

If built on a street corner, a buffer should separate the stoplet from that corner. This buffer can be in the form of a pedestrian bulb, bike corral, bollard that can sustain at least 200 pounds of horizontal force, or comparably durable barrier. It is recommended that stoplets built at street corners be located at the nearside of the intersection.

System Information

Transit system information is mandatory at all stoplets. This information should include the bus schedule or frequency and a system map, in addition to the information conveyed on bus stop signage (see "Signage" recommendations above). Whenever possible, signage should also include fare structure information, the bus route's holiday schedule, a map of services around the stop, real-time schedule information, and a stop name. This information can be posted inside the stoplet shelter, at an adjacent kiosk or display case, or in the window of the adjacent land use. It is highly recommended to illuminate all system information at night, and to include Braille, Spanish, and Chinese translations of all required information.

Additional Amenities

There are four additional amenities that should be incorporated into stoplet design whenever possible. These amenities include a communication device, ticket vending machine, trash receptacle, and bicycle parking. If a communication system is included in the stoplet design, it should be located away from the bus waiting area in a place that does not obstruct the sidewalk, landing pad, bus shelter, or any system information. It should also be located on a side of the intersection that sees high pedestrian traffic and is within clear sight of the stoplet.

If a ticket vending machine is incorporated into the stoplet design, it should be located as close to the shelter as possible without obstructing the bus boarding area or pedestrian traffic. It should also be anchored to the ground to deter vandalism and theft.

A stoplet's trash receptacle should be located adjacent to the shelter in a place that does not obstruct pedestrian movement. It should be placed at least two feet from the curb and at least three feet from other street furniture. It should also be securely anchored to the ground to deter theft and vandalism.

Bicycle parking should either be placed on the street adjacent to the structure or incorporated into the design of the structure if there is a sufficient amount of space. If bicycle parking takes the form of bicycle storage, it should be located away from pedestrian and passenger traffic in a space with an unobstructed view of the stoplet that is well lit at night (see Figure 22).

Figure 22: Stoplet Rendering with Additional Amenity Recommendations

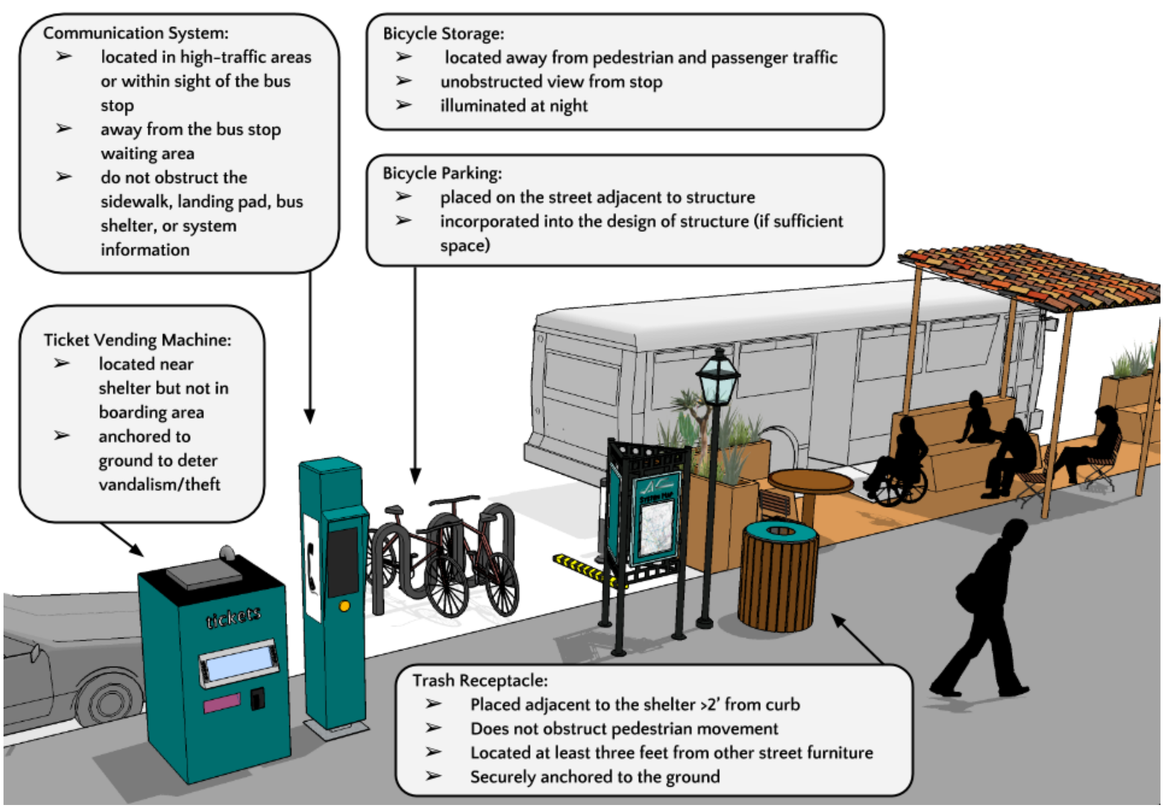


Table 29: Table of Recommendations

Accessibility	• two 5'x8' wheelchair loading pads free of obstructions o 16 feet between the loading pads (for front and back door boarding) • 30''x 48" clear space underneath shelter to accommodate wheelchair • 4' obstruction-free path of travel to bus stop • stable, firm, and slip resistant surfaces • no gaps greater than 0.5" or ramps steeper than 1:20 (5%) • prominent signage that includes info written in braille • seating that accommodates wheelchair users • platform grade that does not exceed 1:48 (2%) slope in either direction

Dimensions	• width = 6' - 7'
	• length = 44'– 120'
	    o Factors to consider in determining specific length
	        ▪ length of existing stop
	        ▪ length of buses along route
	        ▪ desired number of buses for stop to accommodate
	• at least 36" (3') side railing/buffer
	    o capable of withstanding at least 200 feet of horizontal force
	• platform flush with curb
	    o Less than a 0.5" gap between platform and curb

Drainage	• maintain flush connection between curb and platform • don't impede existing curbside storm-water drainage • base not built alongside the curb • screen at either end of drainage to prevent accumulation of debris
Landscaping	• minimize number of places for people to hide • minimize blind spots for bus driver and those waiting at the stop • no foliage higher than 2 feet or lower than 7 feet • cannot interfere with pedestrian or vehicle movement • distinct from other street trees and plants to differentiate transit stop • native and drought tolerant plants highly encouraged
Lighting	• can use current street lamp for lighting if one exists • bright and durable • use energy-efficient, grid-free lighting whenever possible • illuminates space at night • illuminates shelters and signage

Materials	• durable, high-quality, slip-resistant, easily maintained, and aesthetically pleasing
	• special concrete curbing to help guide bus and prevent damage to structure
	• designed to sustain at least 100 pounds per square foot
	• two construction options
	    o concrete with a plastic slip-sheet underneath to keep the base from binding to the road
	        ▪ should not include rebar and weigh less than 200 pounds a square foot
	    o a separate platform and sub-structure that are nailed or screwed together
	        ▪ sub-structure made of wood (ideally pre-treated redwood or cedar) or steel
	        ▪ "Bison" pedestal system for sub-structure
	        ▪ space underneath platform easily accessible for maintenance
	        ▪ concrete curbing to buffer bus from platform
	        ▪ graffiti and damaged parts can be easily removed

Safety Features	• located next to active land uses (businesses, schools, libraries, and housing)
	    o land uses open during normal business hours (or longer)
	    o structure highly visible from window
	• good lighting
	• not obscured by nearby trees, poles, or buildings
	• amenities minimize amount of hiding spaces and don't hinder visibility
	• shelters built with transparent and graffiti-resistant glass panels
	• clear line of sight for bus drivers and pedestrians when approaching the stop
	• four-foot buffer on either end of stoplet
	    o protected by a wheel stop
	    o made visible with soft-hit posts or bollards
	• guardrail along structure edges to define space and protect against wayfaring vehicles
	    o at least 3' tall
	    o capable of withstanding at least 200 feet of horizontal force

	• if placed at street corner, additional buffer next to corner o pedestrian bulb, bike corral, or bollard that can sustain at least 200 pounds of horizontal force
Seating	• not placed in a way that obstructs wheelchair movement • seating facing the street at least 2' from curb • allows for clear path of travel to structure • does not impede pedestrian flow along sidewalk • placed underneath shelter when present • shaded, illuminated, and sufficiently protected from the elements whenever possible • portable seating is light, durable, easy to move, and weather-, graffiti, and fire-resistant • arms on seats to assist elderly and deter sleeping • enough permanent seating for 3 people to sit • mix of permanent and temporary seating • table and chair design distinct from business' to emphasize public nature of space
Shelter	• made out of strong, durable, and easily cleanable materials • provides shade during the day, protection from elements (trees and umbrellas can supplement) • at least 80 inches tall • sides (optional) are transparent, allowing operator and passenger to see inside and out • neighborhood-specific design • large enough to accommodate wheelchairs • two-foot buffer between shelter and curb • does not impede pedestrian traffic • does not obstruct view of adjacent business • includes lighting • contains real-time information, push-to-talk button, map, schedule, leaning rail, phone, and benches (optional)
Signage	• double-sided and reflectorized • contains font, color, and appearance unique to transit system • includes bus route number, route destination, and unique stop identification (recommended) • placed close to where passengers board the front door • located at least 2 feet from curb's edge • posted at least 7 feet high if on a pole • not obstructed by trees, buildings or other signage • located at least eight feet from the bus shelter or bench • additional signage indicating structure is a public space
Street Conditions	• install on streets with speeds 25 mph or under • install on streets with no more than a 5% grade or a 2% cross slope • prioritize on streets with low traffic volumes, high pedestrians volumes, narrow sidewalks, more than one lane in each direction, and at nearside bus stops • If built on a street corner, buffer with a pedestrian bulb, bike corral, bollard that can sustain extreme force, or other barrier

System Information	• necessary information:
	  o bus route
	  o Schedule (or frequency)
	  o map
	• desired information:
	  o agency logo
	  o real-time information (can be placed in business window)
	  o fare structure
	  o holiday schedule
	  o maps of services around the stop
	• stop name/number
	• posted inside shelter, or in display case, kiosk, or business
	• displayed in large print
	• illuminated at night
	• translated into Braille, Spanish and Chinese whenever possible

Additional Amenities	• communication Systems
	  o located in high-traffic areas or within sight of the bus stop
	  o away from the bus stop waiting area
	  o do not obstruct the sidewalk, landing pad, bus shelter, or system information

	• ticket vending machines
	  o located near shelter but not in boarding area
	  o anchored to ground to deter vandalism/theft

	• bicycle storage/parking
	  o storage
	    ▪ located away from pedestrian and passenger traffic
	    ▪ unobstructed view from stop
	    ▪ illuminated at night
	  o parking
	    ▪ placed on the street adjacent to structure
	    ▪ incorporated into the design of structure (if sufficient space)

	• trash receptacles
	  o placed adjacent to the shelter at least 2' from curb
	  o does not obstruct pedestrian movement
	  o located at least three feet from other street furniture
	  o securely anchored to the ground

CONCLUSION

Findings from this paper's meta-analysis validate the feasibility of the stoplet concept. While there are still challenges to overcome, the potential benefits to rider safety, security, and accessibility, and improvements in transit efficiency, cost-effectiveness, and local economic development far outweigh the potential risks associated with piloting such a program. The project's greatest challenges lie in how to best ensure the safety of its users from bus-stoplet collisions and how to most equitably distribute financial responsibilities for infrastructure, insurance, and maintenance costs.

The project's suitability analysis assesses potential stoplet locations throughout Alameda County based on the location of bus stops, retail businesses, and parklet programs, the slope and speed of each street, and the median income and proximate park space of each household. The analysis concludes that stoplets are best suited at bus stops in Oakland and Berkeley, with a particular focus on the two cities' downtowns, as well as the neighborhoods of Arroyo Viejo (Oakland), Castlemont (Oakland), Elmwood (Berkeley), Fruitvale (Oakland), Hoover-Foster (Oakland), Piedmont Ave (Oakland), San Antonio (Oakland), and Southside (Berkeley).

Despite this paper's findings on the potential benefits, relevant design considerations, and ideal locations for stoplets throughout Alameda County, AC Transit is nonetheless likely to question the wisdom of implementing such an untested idea. While change can be difficult, it is important to consider the cost of maintaining the status quo. Currently, only 58% of AC Transit's 5,533 bus stops are accessible to the disabled community, while only 40% contain places to sit, 24% display system information, and 20% have protection from the elements. Meanwhile, system ridership has decreased over 25% per capita over the past 25 years. Research indicates a direct correlation between system ridership and the customer waiting experience. Thus, if the agency hopes to increase system ridership and retain its existing customer base, it must improve its bus stops.

The stoplet concept presents AC Transit with a low-cost strategy to improve bus stop accessibility, comfort, safety and security that simultaneously boosts the local economy and creates new public gathering spaces for the community. The agency has already been awarded a $100,000 grant from the regional transportation authority to establish the framework for such a program. This paper provides an additional resource to help jumpstart that process. It is now incumbent on the agency to move this idea from concept to reality. By implementing a successful stoplet program in Alameda County, AC Transit has the power to both improve its customers' bus waiting experience and inspire a worldwide revolution to re-invent the bus stop.

Appendix

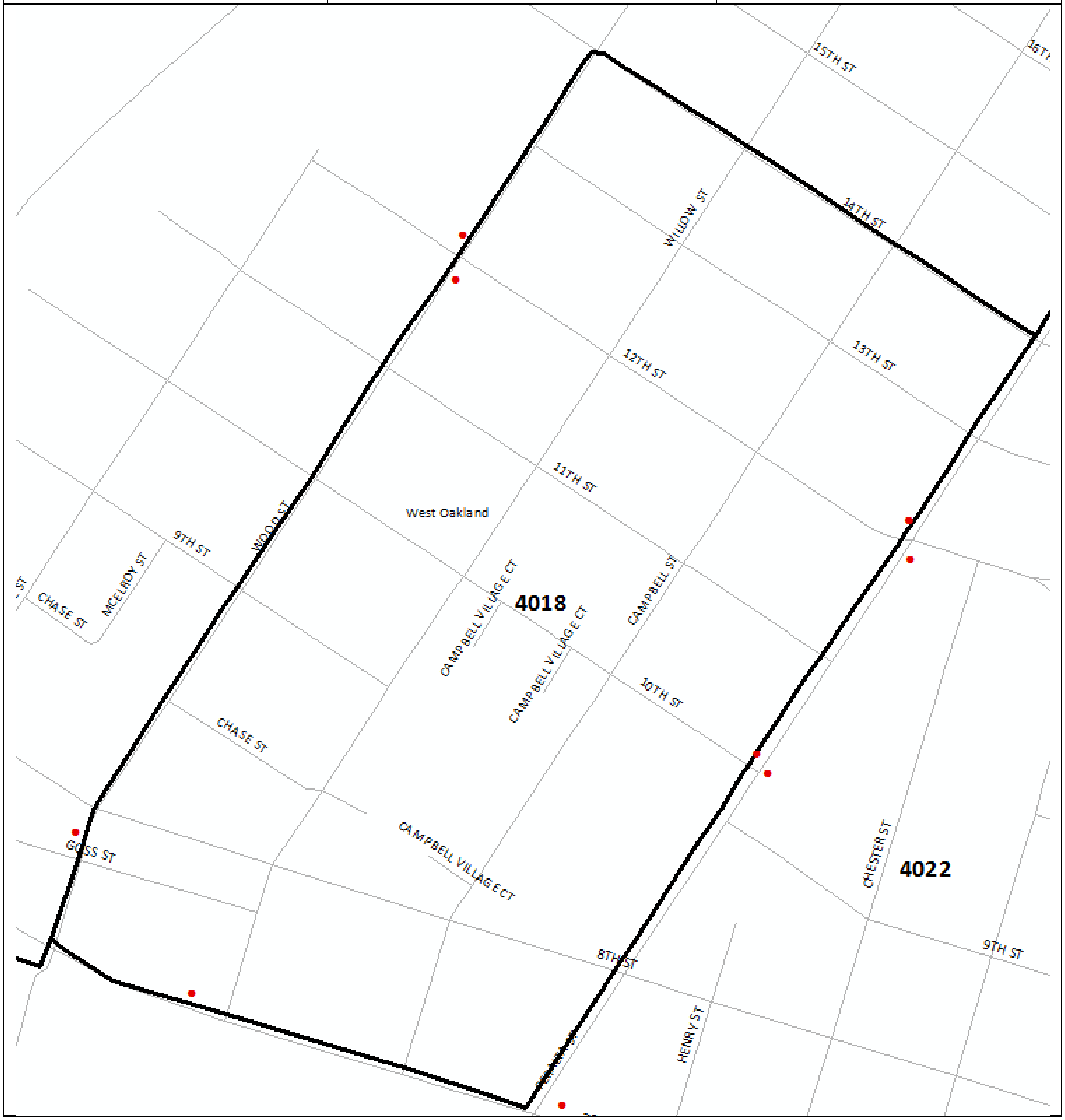
GIS Suitability Analysis Data Sources

- **Alameda County median household income** = 2010 Census data (census.gov)
- **Alameda County public parks shapefile** = Provided by Stephen Newhouse, Alameda-Contra Costa Transit District
- **Alameda County bus route shapefile** = Provided by Stephen Newhouse, Alameda-Contra Costa Transit District
- **Alameda County bus stop shapefile** = Provided by Stephen Newhouse, Alameda-Contra Costa Transit District
- **Bay Area retail business locations** = Provided by UCLA Lewis Center (National Establishment Time-Series Data, 2010)
    - Specific NAICS codes incorporated into study:
        - 4451- Grocery stores
        - 4452 - Specialty food stores
        - 448 - Clothing and clothing accessory stores
        - 451 - Sporting goods, hobby, musical instrument, and book stores
        - 4531 - Florists
        - 4532 - Office supplies, stationery, and gift stores
        - 4533 - Used merchandise stores
        - 45391 - Pet and pet supplies stores
        - 45392 - Art dealers
        - 7224 - Drinking places
        - 7225 - Restaurants and other eating places
- **Grade of street =** United States Geological Survey data (viewer.nationalmap.gov/viewer/)
    - Digital Elevation Model (DEM)
        - Scale = 1/3 Arc-second (10 meter)
- **Oakland street speed limits** = Shapefile manually created based on data from Oakland Municipal Codes 10.20.020 - 10.20.070 (https://www.municode.com/library/ca/oakland)

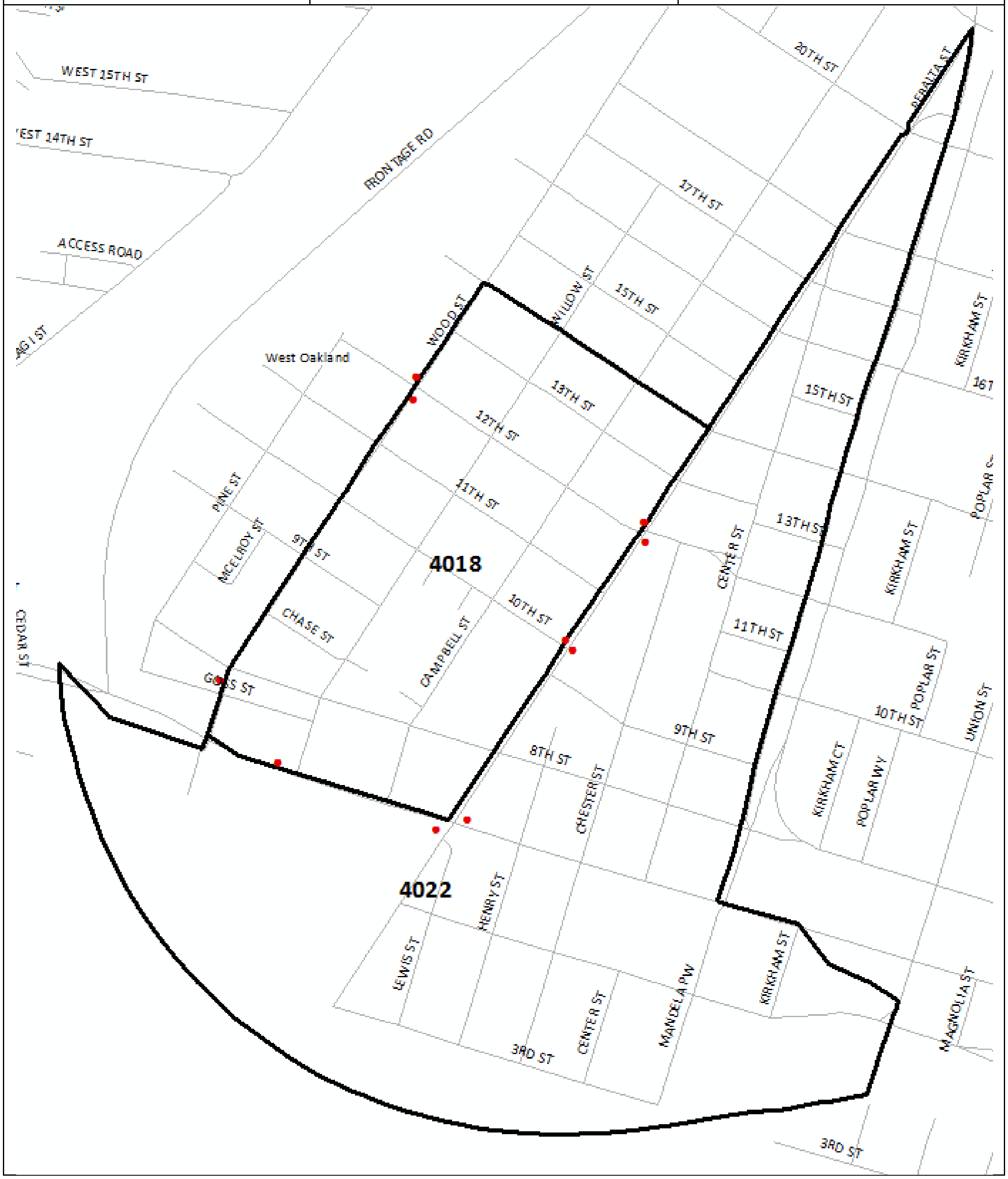
GIS Suitability Analysis "Stoplet Suitability Index" Priority Areas

Census Tract	Neighborhood	Number of Potential Stoplet Locations
4013	Hoover-Foster	5

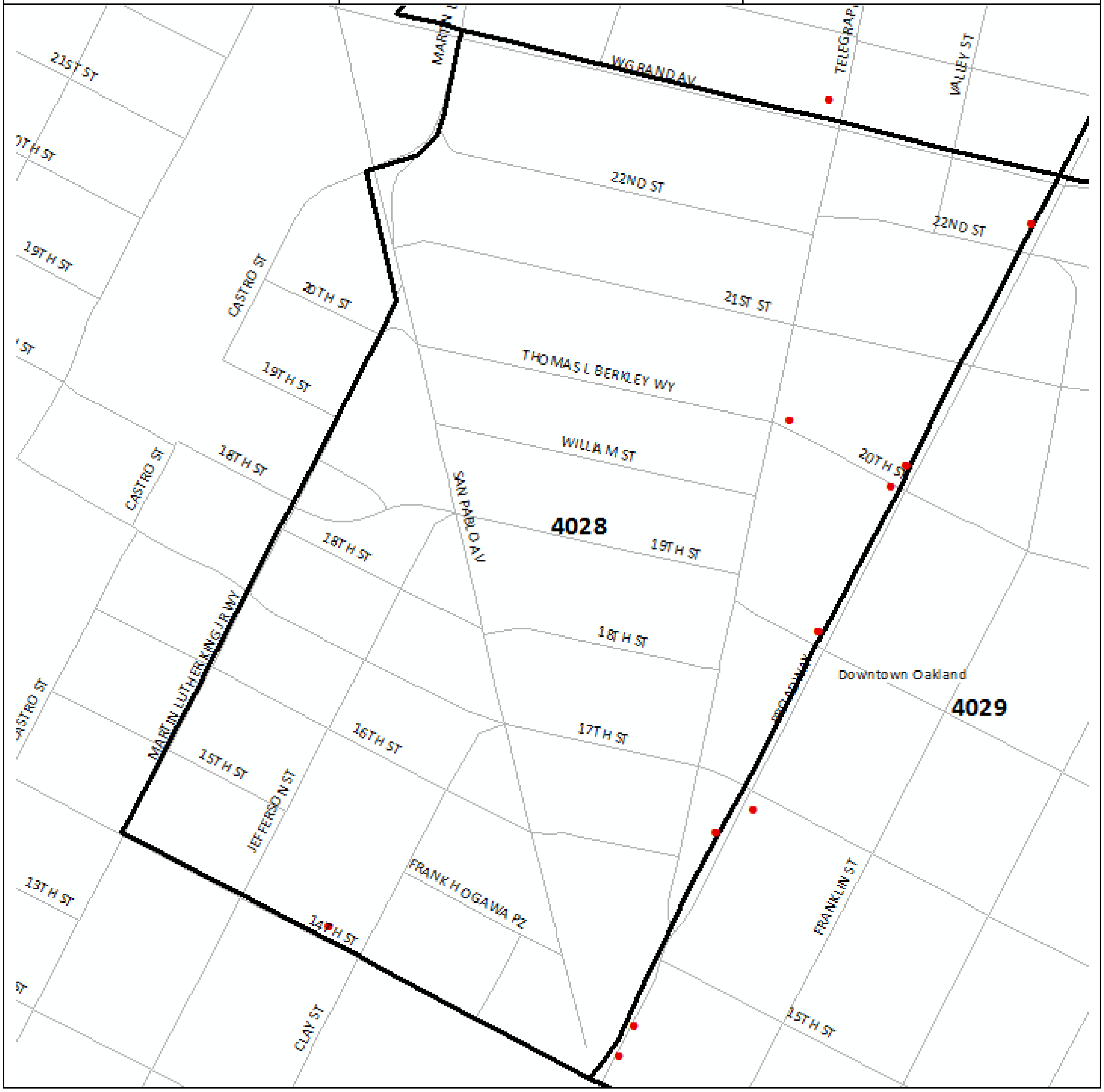
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4018	West Oakland	3



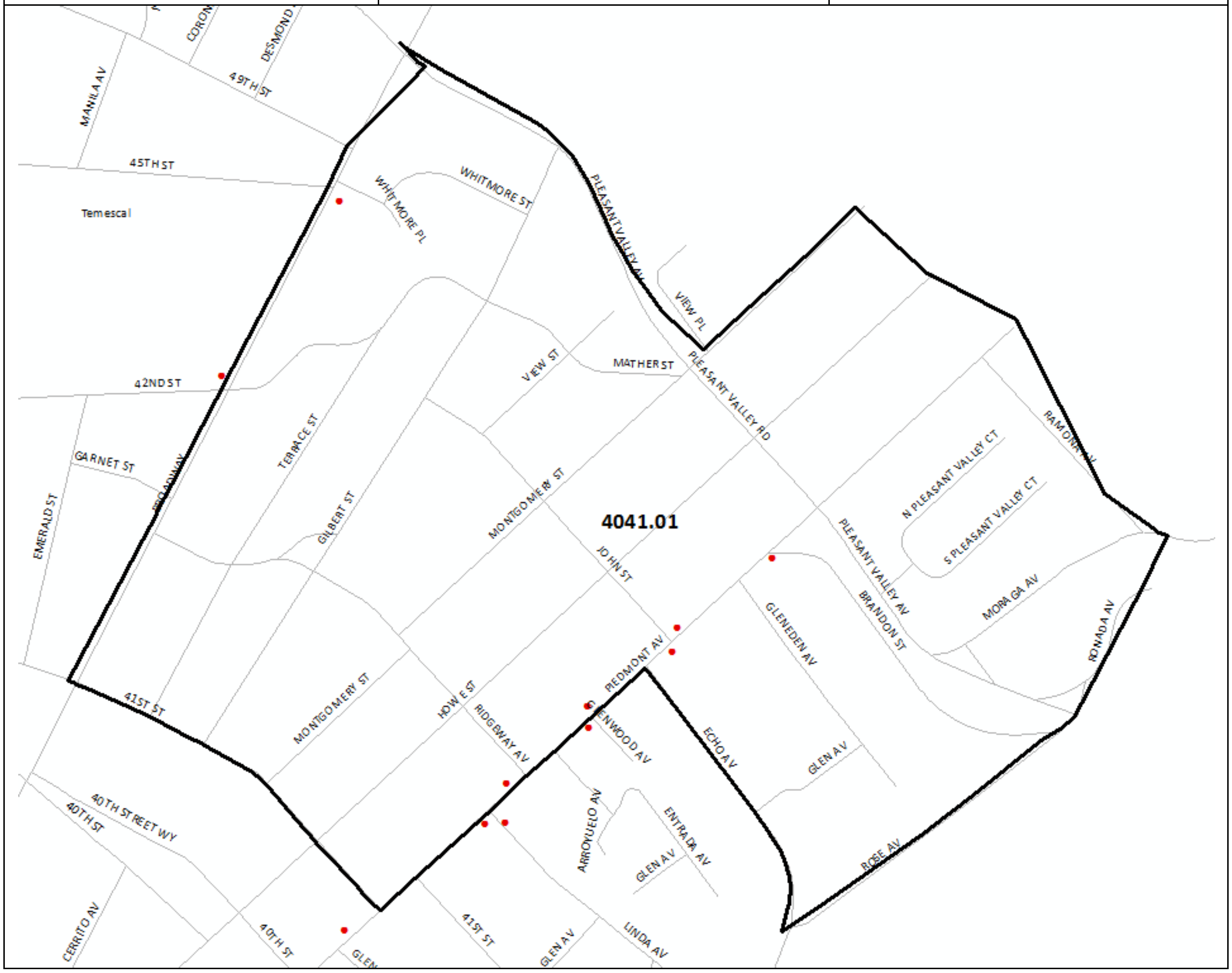
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4022	West Oakland	5



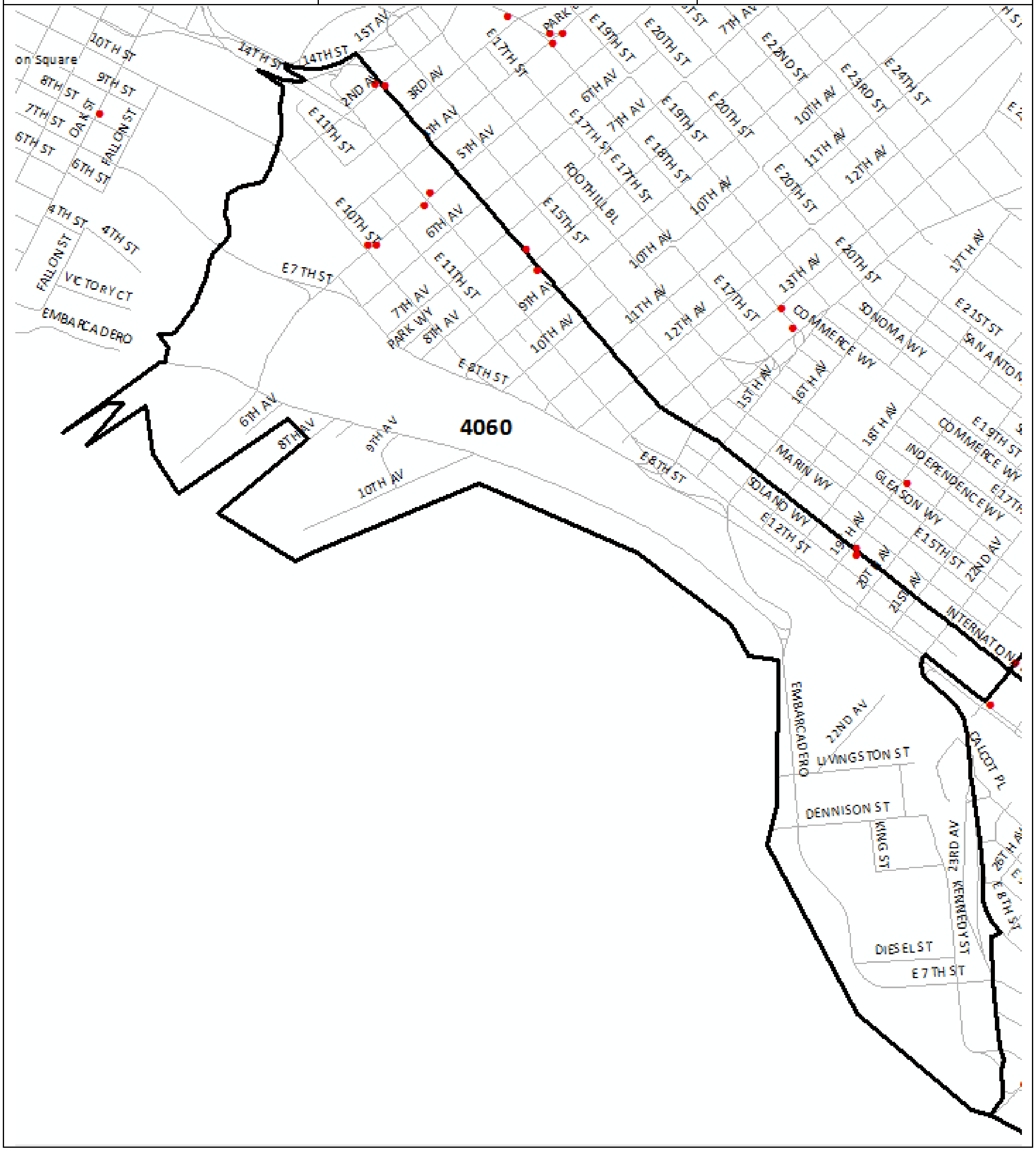
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4028	Hoover-Foster	7



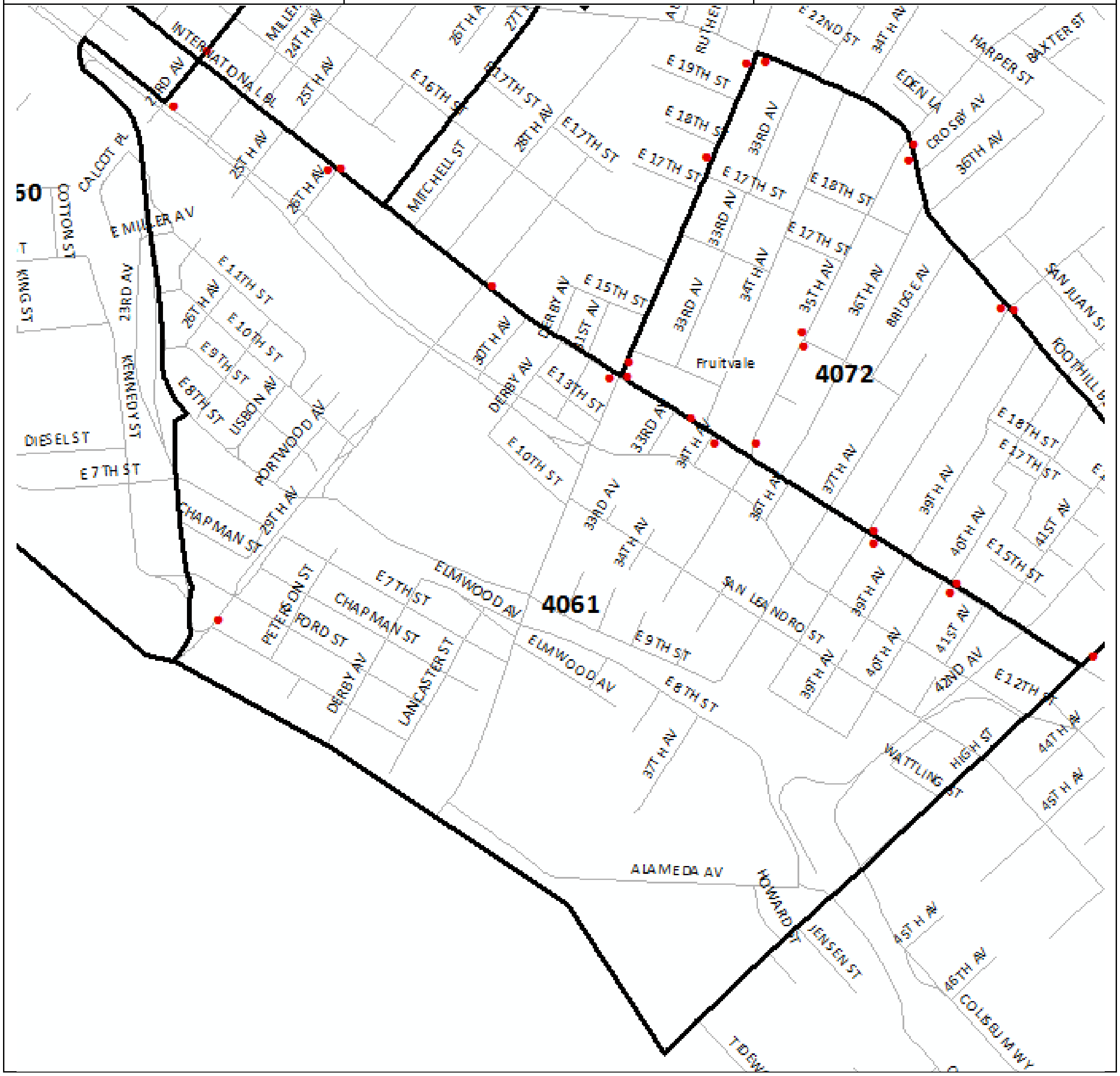
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4041.01	Piedmont Ave	6



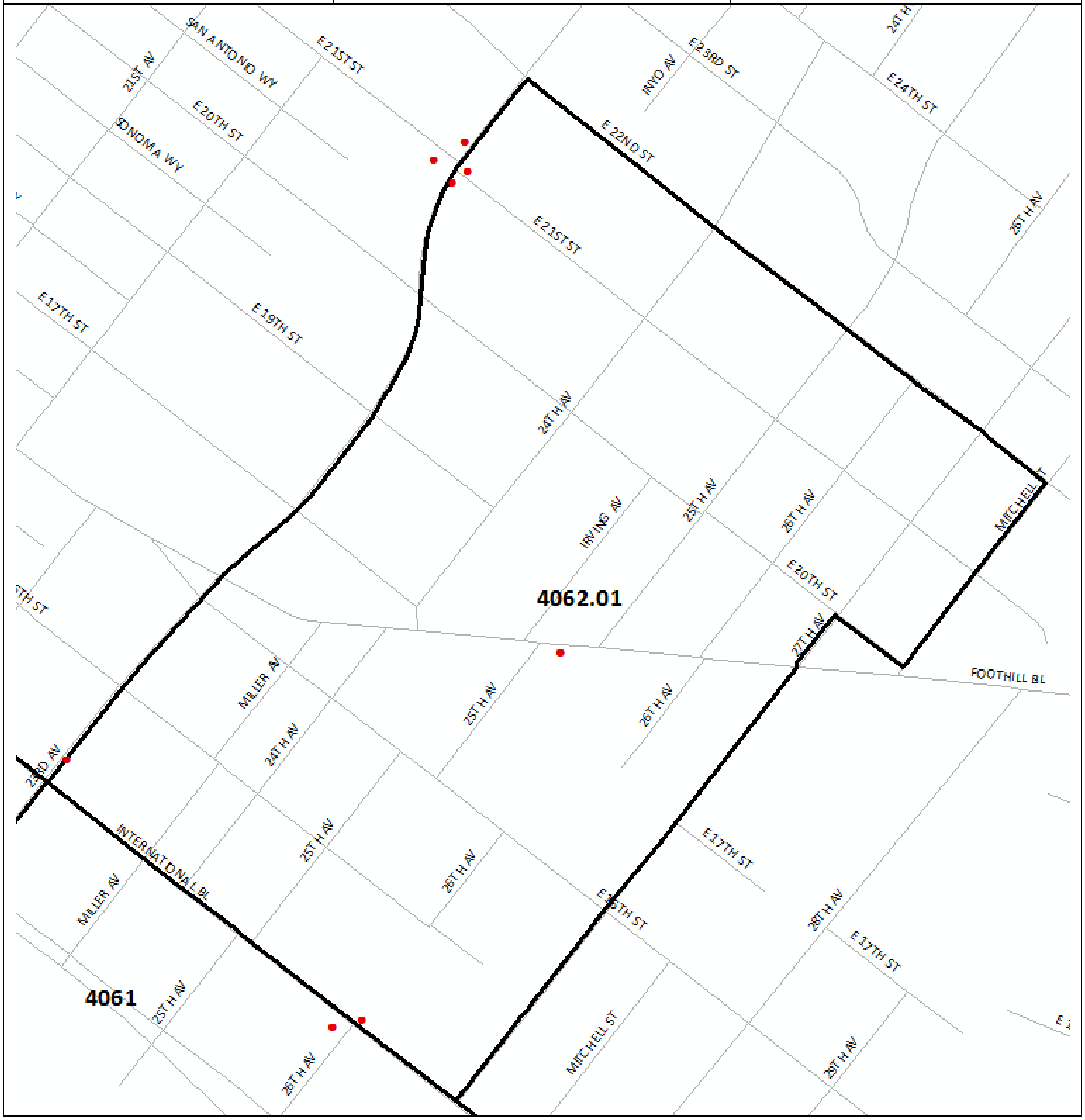
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4060	Fruitvale	7



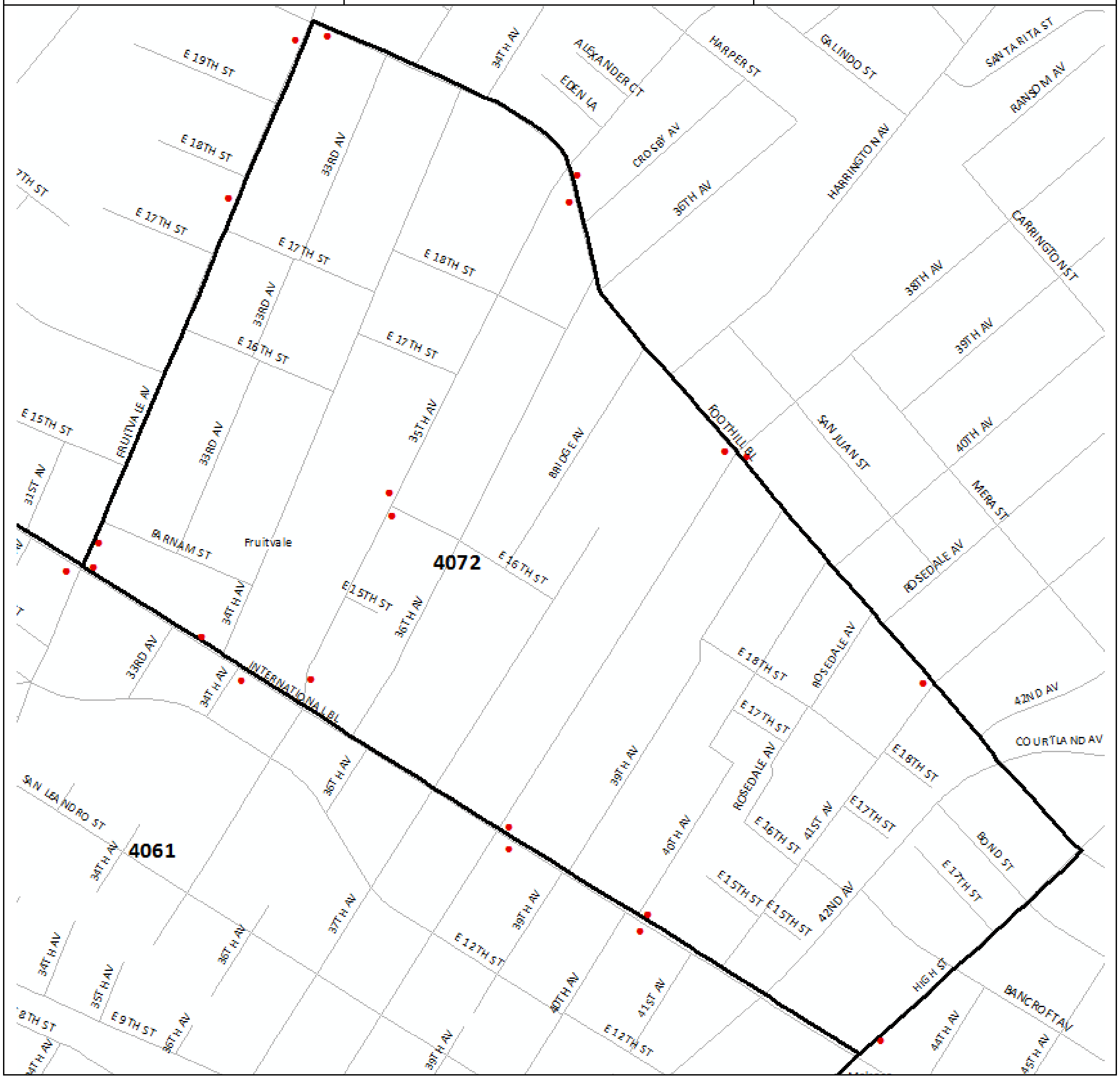
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4061	Fruitvale	7



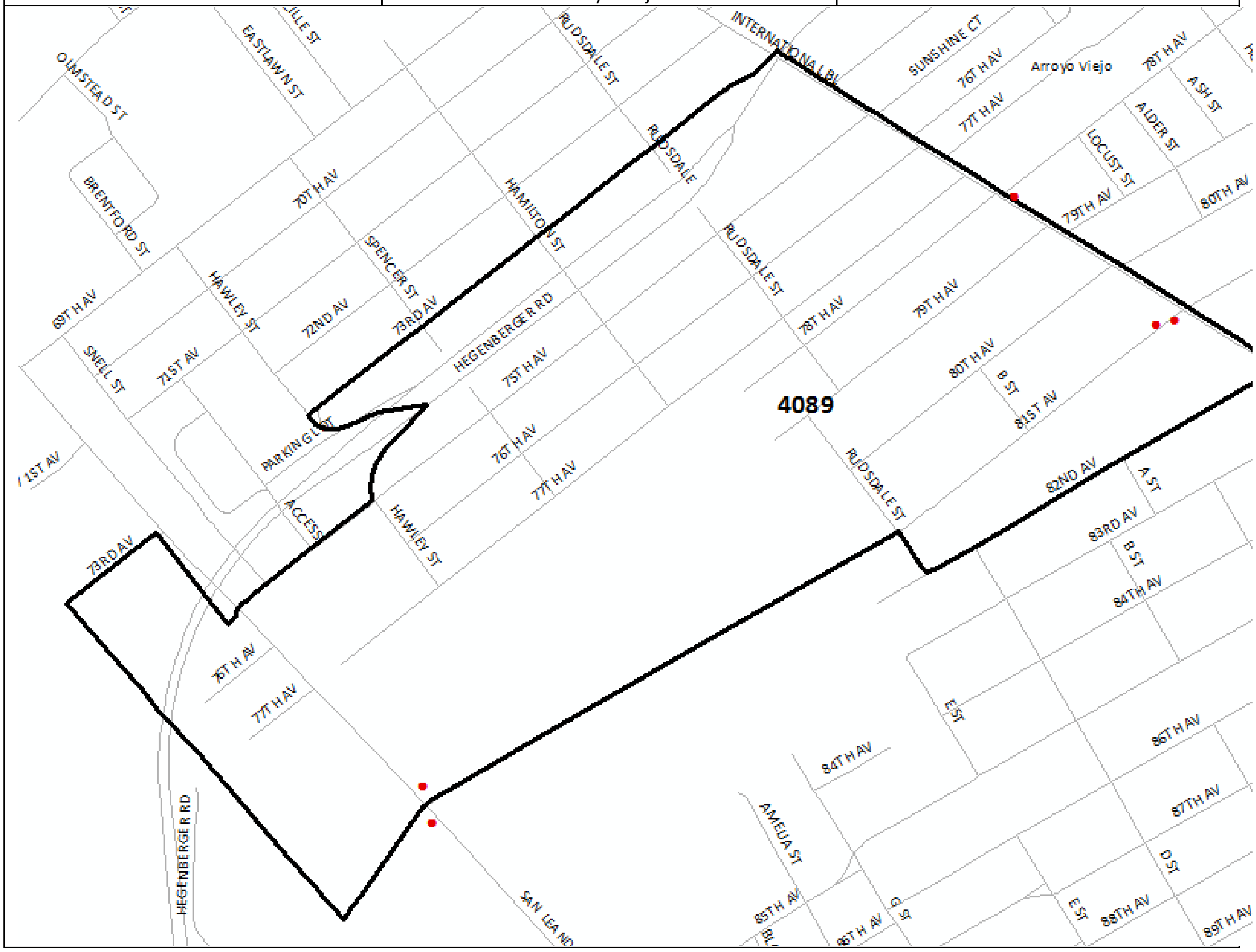
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4062.01	San Antonio	5



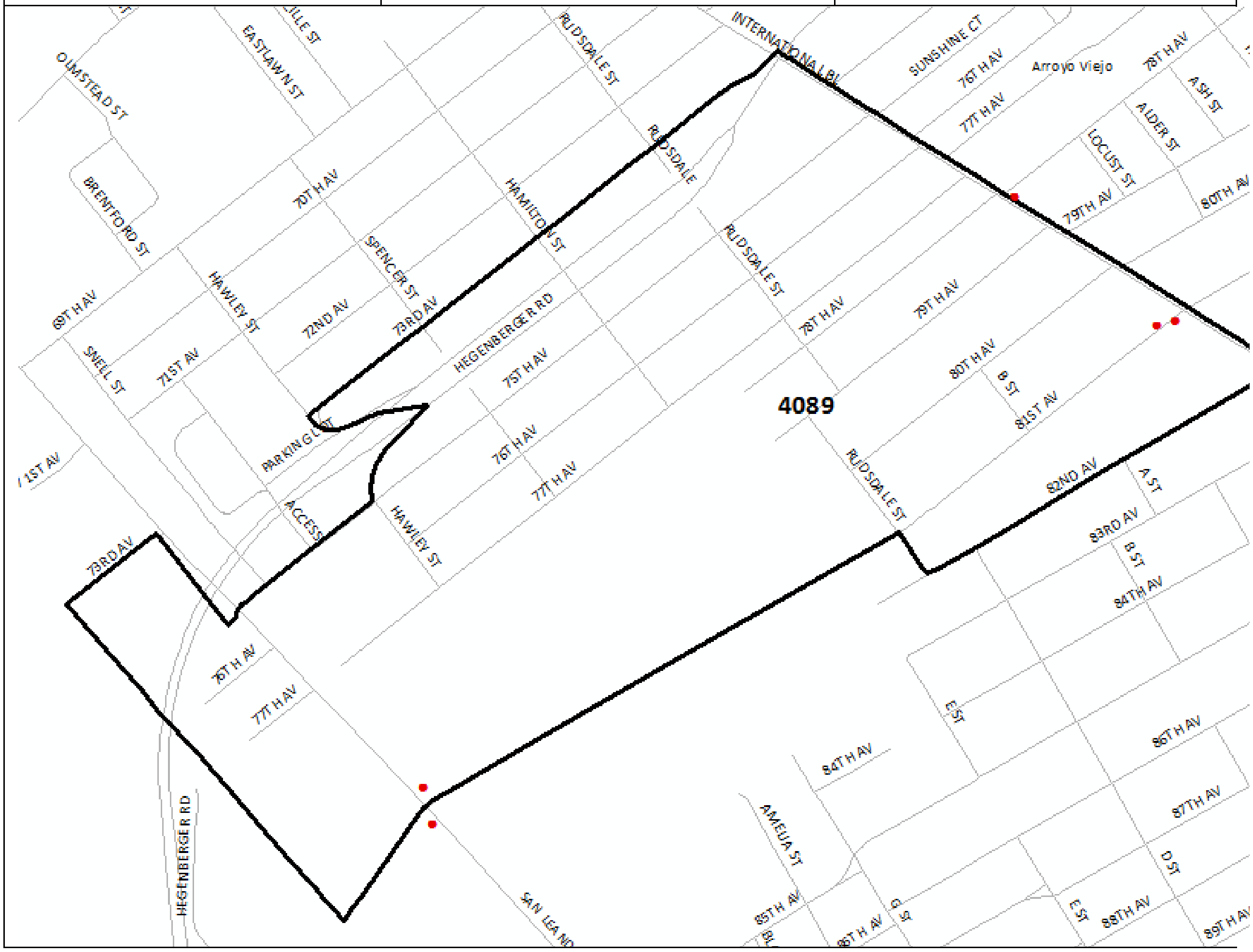
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4072	Fruitvale	12



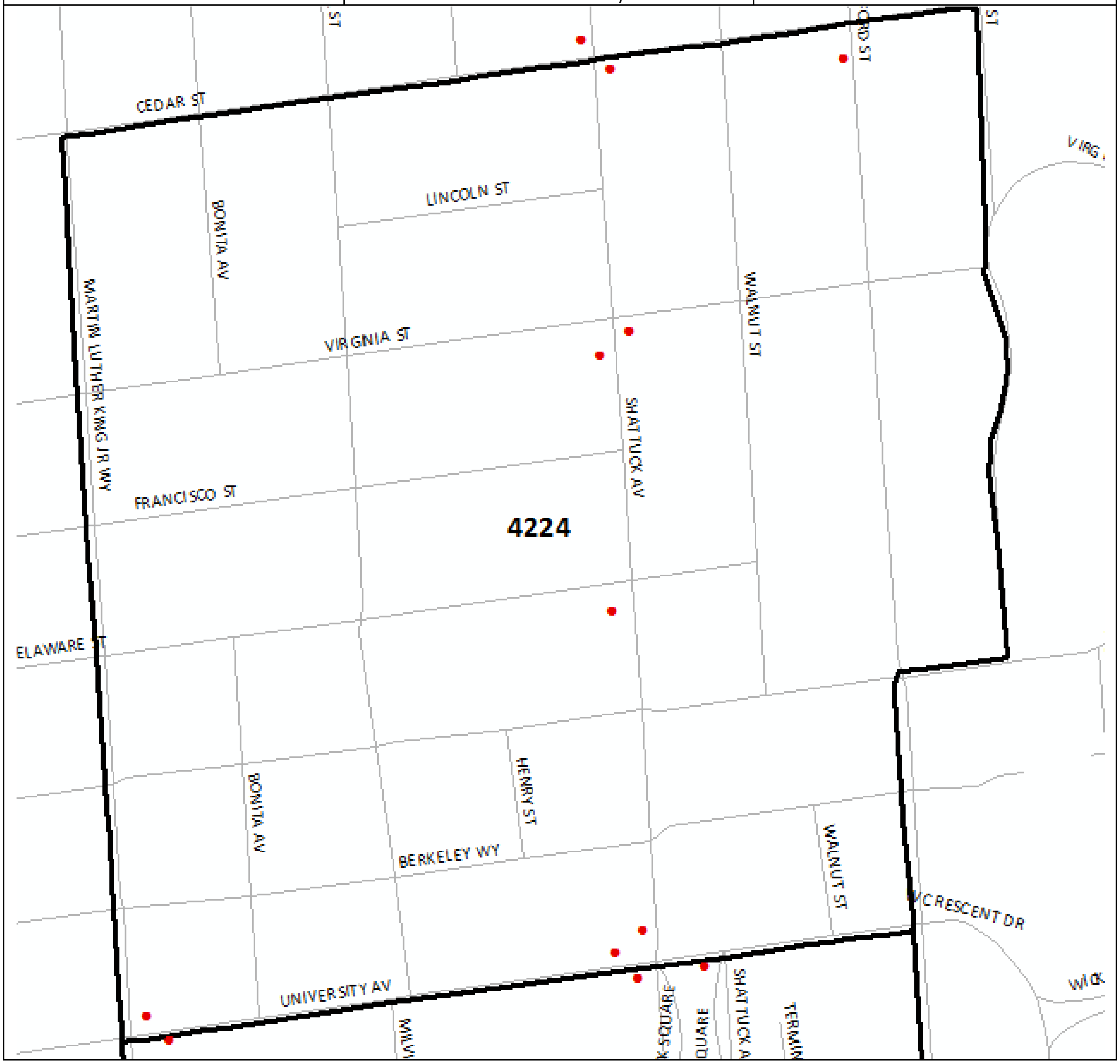
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4089	Arroyo Viejo	3



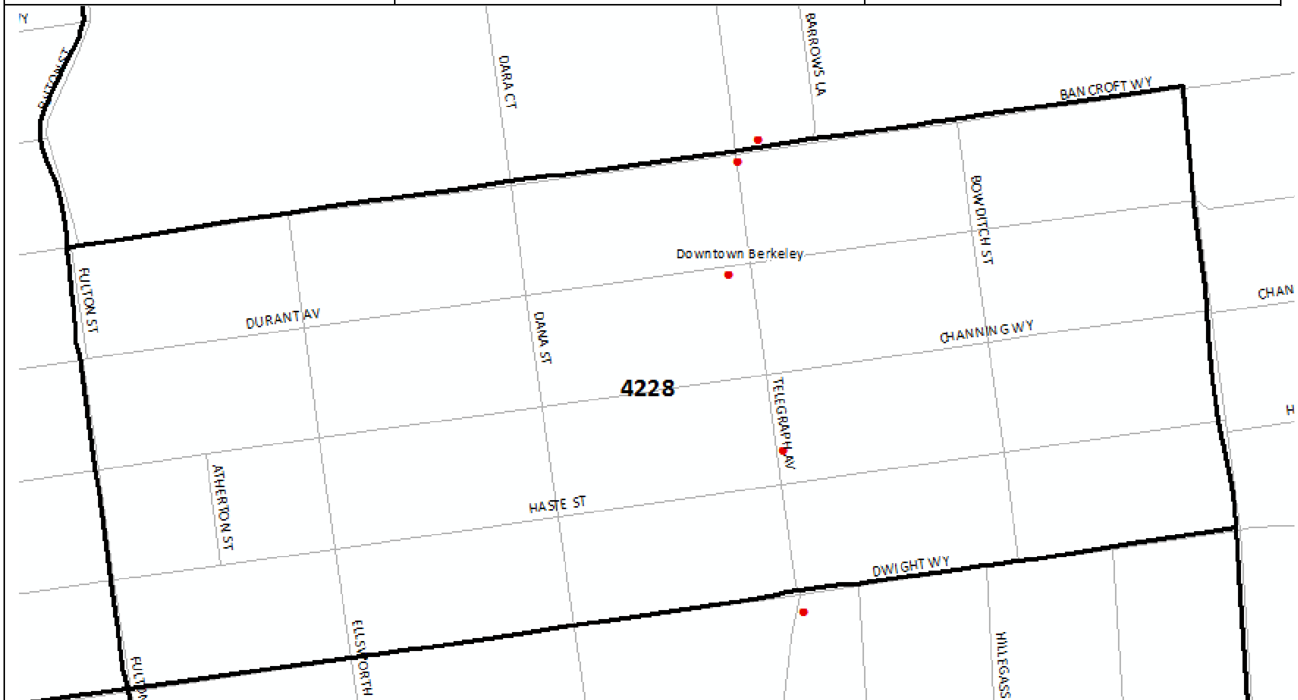
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4097	Castlemont	3



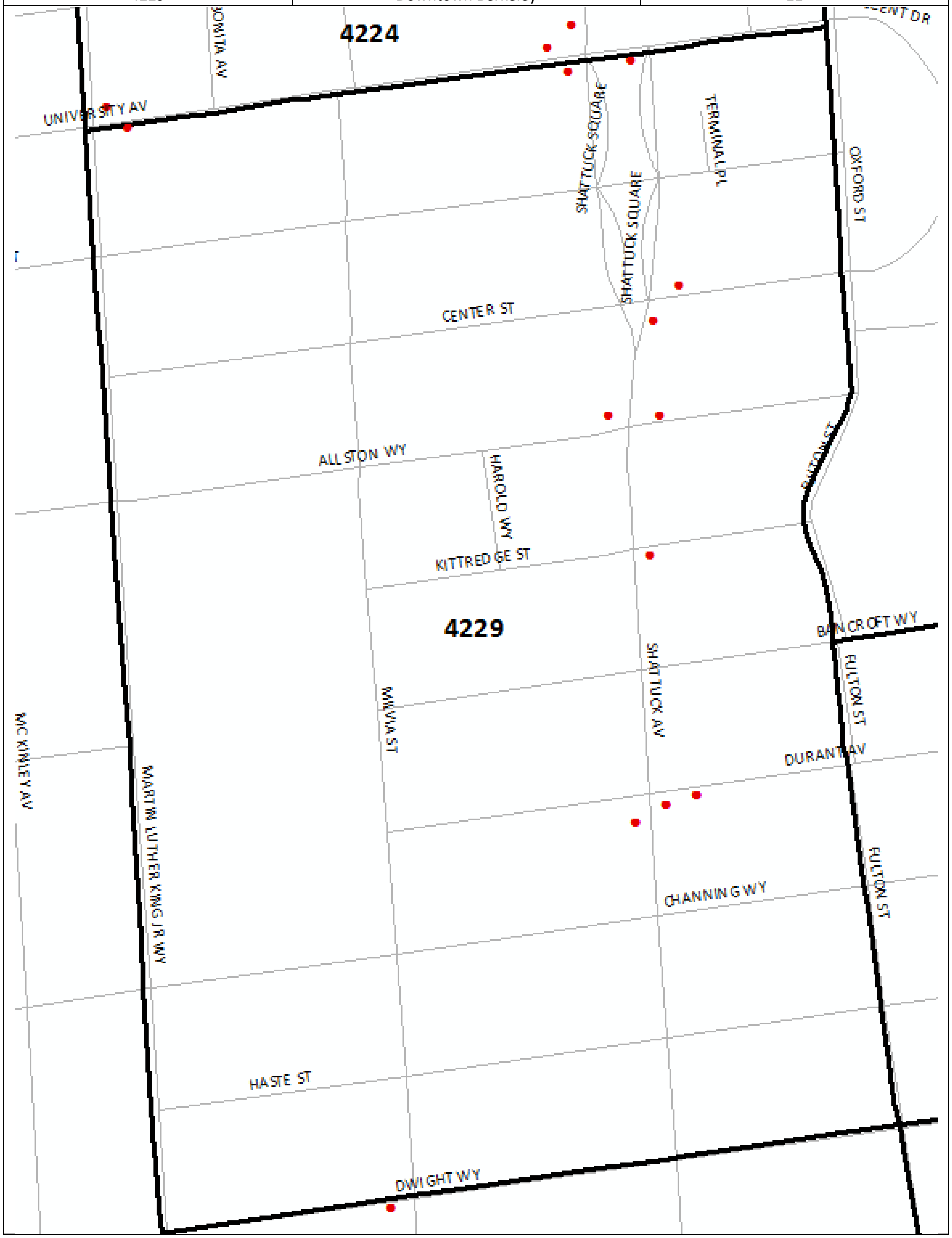
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4224	Downtown Berkeley	8



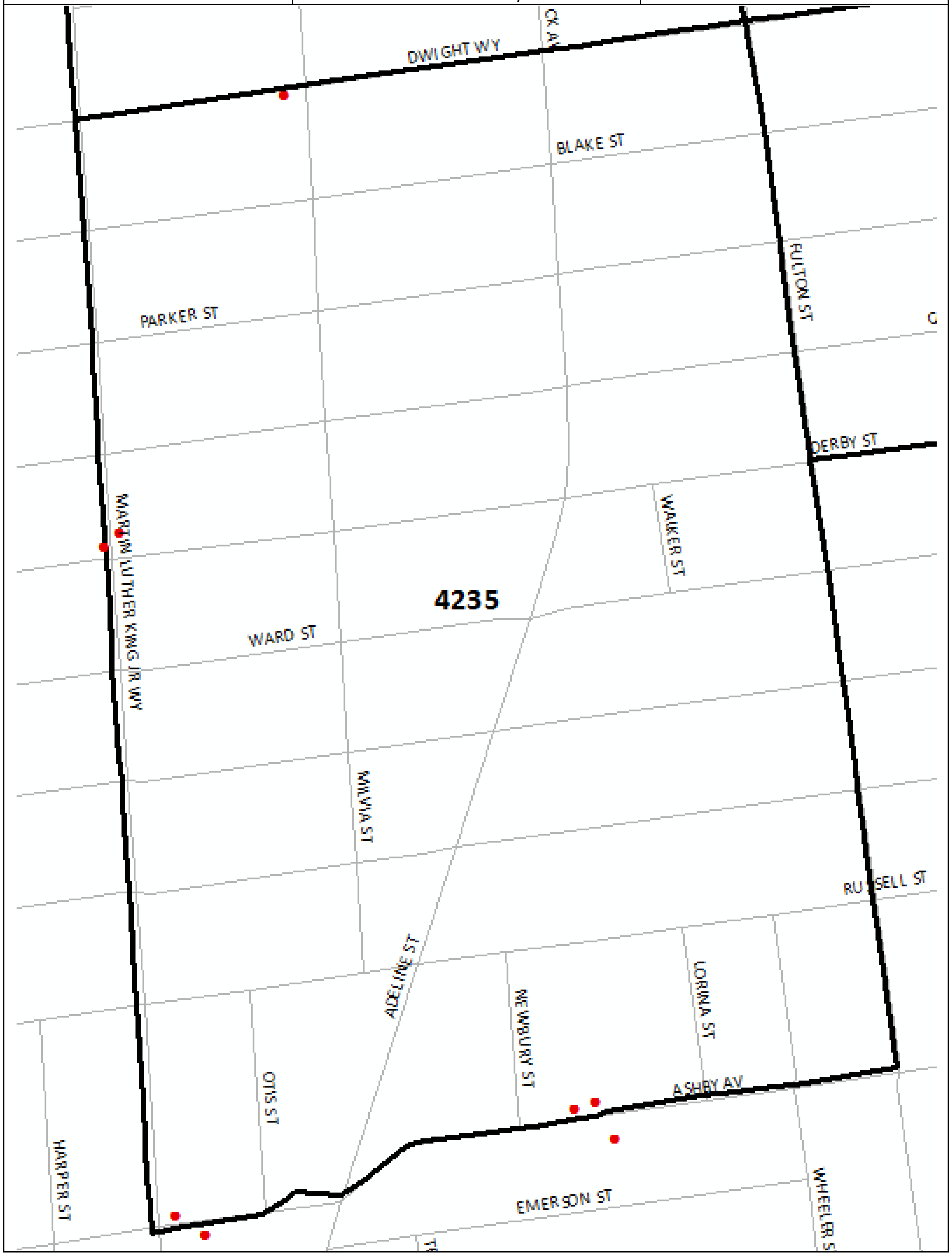
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4228	Southside	3



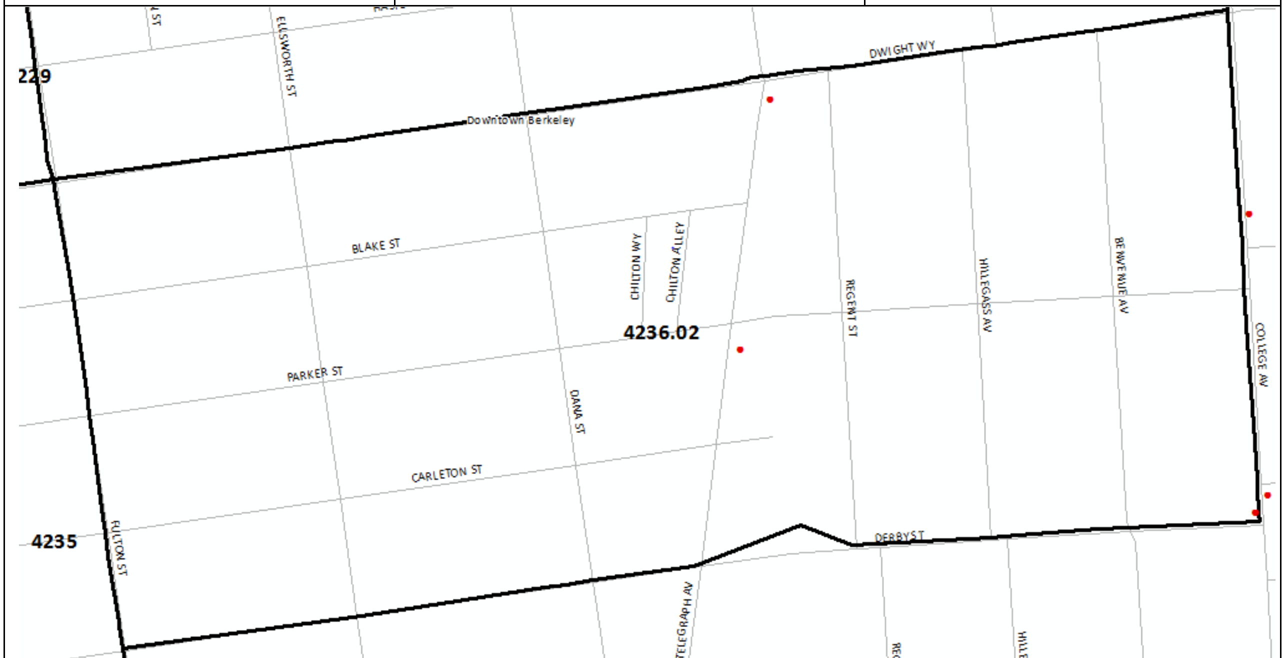
Census Tract	Neighborhood	Number of Potential Stoplet Locations
4229	Downtown Berkeley	11



Census Tract	Neighborhood	Number of Potential Stoplet Locations
4235	South Berkeley	6



Census Tract	Neighborhood	Number of Potential Stoplet Locations
4236.02	Elmwood	3



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