BLACOW ROAD IMPROVEMENT PLAN

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Approval Page

Title: Blacow Road Improvement Plan

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Acknowledgments

Thank you, Professor Cornelius Nuworsoo, for your continued support and guidance - I would not have stumbled across the field of transportation planning without your words of wisdom.

To my supervisors Tori Winters and Monica Munowitch from the San Francisco Municipal Transportation Agency: thank you for introducing me to Complete Streets work.

To Dave Mills, Amy Lopez, and Mike Alston from Kittelson & Associates: thank you for getting me involved with transportation engineering projects.

A special thank you to my friends and family for their unconditional love and encouragement!

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Executive Summary

Providing safe and accessible entrances to schools, especially elementary, middle, and high schools where children are below the age of 18, should be of utmost priority to cities. Providing wide sidewalks, painted bicycle lanes and continental crosswalks (with the lateral lines) are just basic infrastructure improvements that can be made within the vicinity of a school. However, due to lack of funding or attention from the city departments, many school entryways are being neglected and the direct impact of this is increased collisions among students, drivers, and bicyclists. My senior project studied one such school in Fremont, California where the entrance is not very efficient or safe for any mode of transport, including pedestrian traffic.

There are two reasons why I chose this school – one, I am an alumna of Irvington High School and two, there have been multiple student deaths reported in the last few years which are one too many. Through this study, I hoped to shine light on some of the reasons why this street segment has not yet been improved, one of them being the high percentage of low-income residents, immigrants, and People of Color (POC) who live in the vicinity. Therefore, the study's scope stretched far beyond the constraints of safer engineering and road infrastructure – the problem also lies in inequity, discrimination against certain groups, and the disproportionate distribution of funding (in wealthier areas of Fremont versus the Irvington District).

Using literature from previous studies done in the area and similar plans implemented in other cities, I developed a Street Improvement Plan which can increase the safety and accessibility near Irvington High School. The improvements focus on Blacow Road between Fremont Boulevard and Grimmer Boulevard. Recommendations are designed to satisfy four sets of goals which include:

- Improved **safety** and **convenience** for all roadway users and all modes
- Better **accessibility** and circulation for all roadway users and all modes
- A **well-connected** active transportation infrastructure
- **Cost-effective** and efficient roadway treatments

CHAPTER 1

COMMUNITY PROFILE

A Brief History of Fremont

The City of Fremont, hereafter referred to as "the City" was founded in 1795 by Fermin Lasuen, a Spaniard Father. Located in the southern part of East Bay in the San Francisco Bay Area, it is considered one of the largest suburbs in the region. Incorporated in 1965, it now encompasses five small districts namely Irvington, Centerville, Mission San Jose, Niles, and Warm Springs. As shown in Figure 1.1 on Page 3, Fremont also shares its borders with the two smaller cities of Newark and Union City, collectively known as the Tri-City Area among the locals (City of Fremont).

The study area for this project is in the Irvington District which is in the south-Central region of Fremont. As seen in Figure 1.2 on Page 3, the district is bound by Auto Mall Parkway and Mowry Avenue, from I-880 to the Fremont Bay Area Rapid Transit (BART) station (Irvington Business). Although Irvington was considered an agricultural and commercial hub when it was first established, it now primarily consists of residential neighborhoods with a few retail and commercial strips. The area serves two school districts – Irvington and John F. Kennedy – both of which are well-ranked in the community (Irvington Business).

Demographics

The United States Census Bureau (USCB) community profile for the City of Fremont identifies its population to be just over 235,000 dispersed over 77.4 square miles. The 2019 American Community Survey (ACS) 5-Year Estimates place Irvington District's population around 66,000 which makes up 28 percent of Fremont's total population. In comparison to its nearby cities and its encompassing districts, Fremont is home to a larger population of People of Color (POC). However, there are noticeable variations in age and socio-economic characteristics between these places (US Census Bureau, n.d.).

Race and Ethnicity

Traditionally a diverse community, Fremont has seen a significant increase in the Asian population in the last two decades; as of 2010 more than half of its residents were of Asian ancestry. Figure 1.3 breaks down the racial makeup of Fremont and Irvington District in 2019. Within the Asian population, many identify themselves as Chinese, Asian Indians, and Filipinos, as shown in Figure 1.4 on Page 4. This may be due to the competitive school districts, numerous employment opportunities in the vicinity, the City's proximity to Silicon Valley, or the increasing quality of life, all of which are appealing to the immigrant population (US Census Bureau, n.d.).

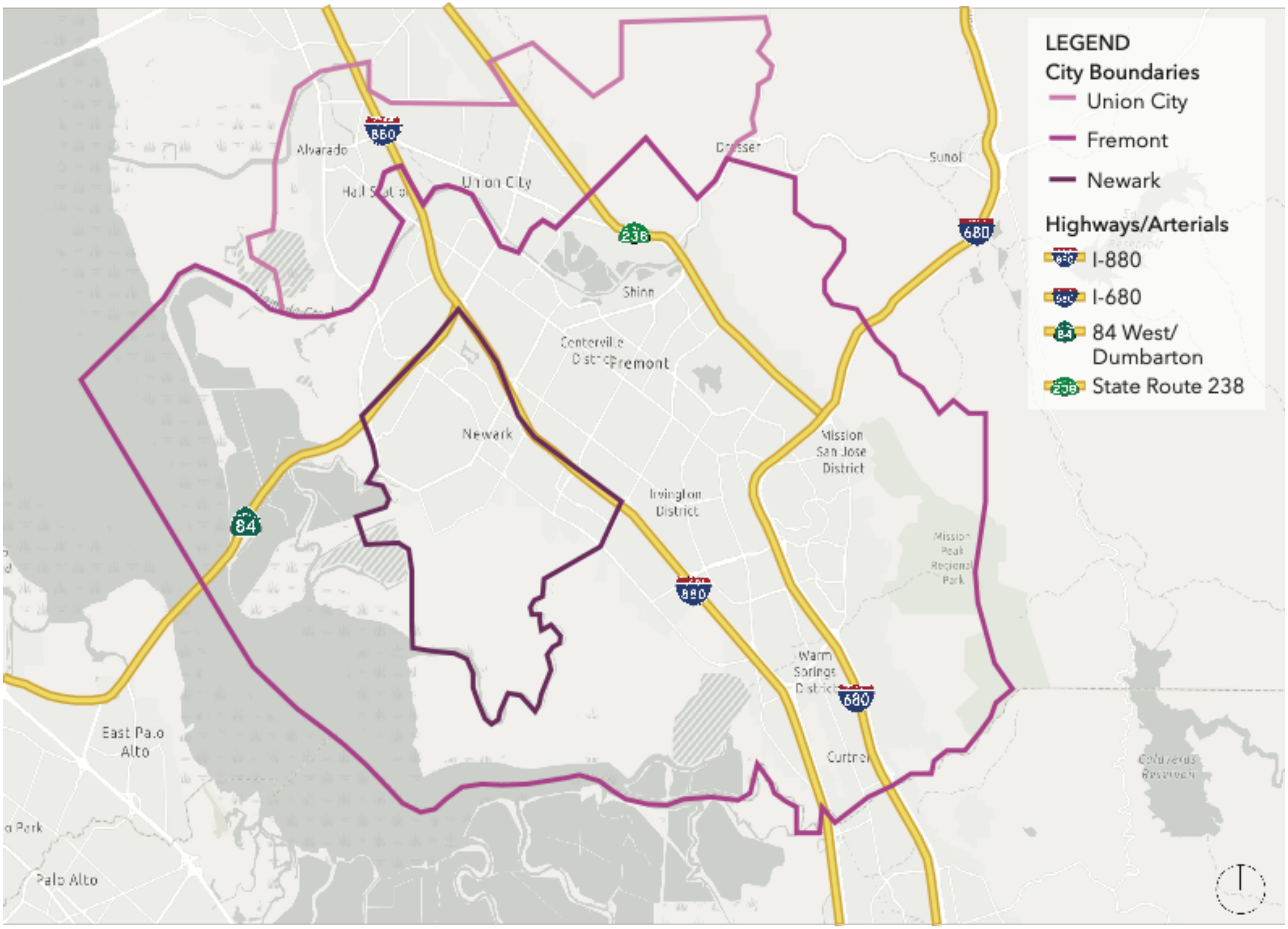


Figure 1.1: Tri-City Area, Bay Area, California

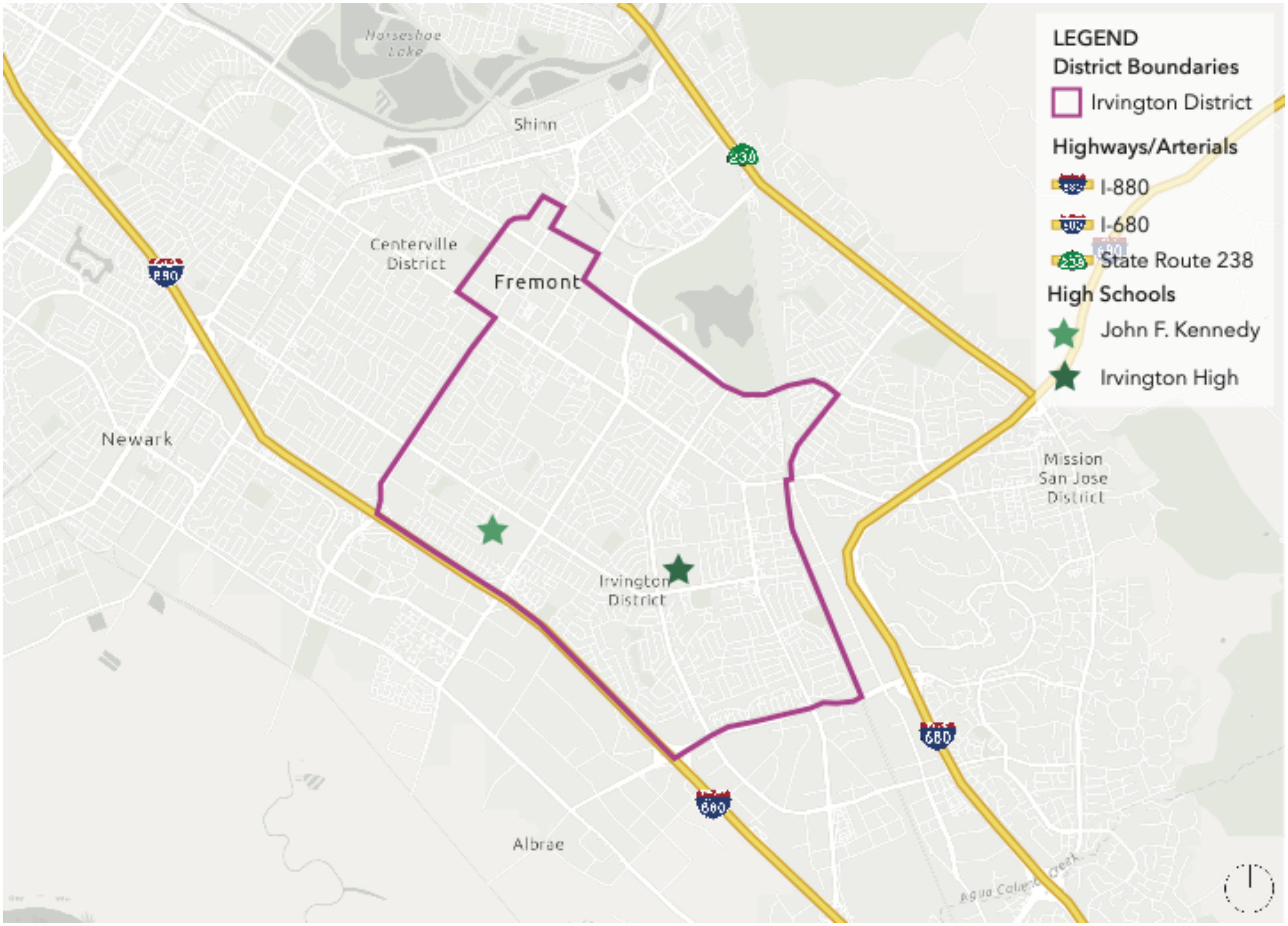


Figure 1.2: Irvington District in Fremont, California

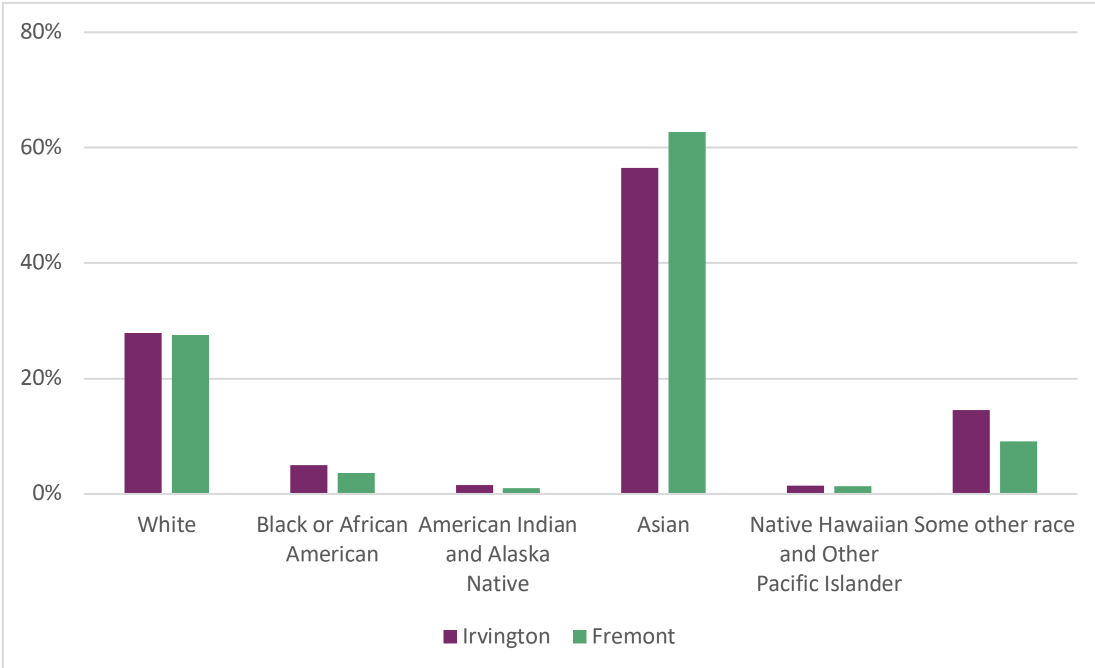


Figure 1.3: Race Breakdown in Fremont and Irvington (2019)

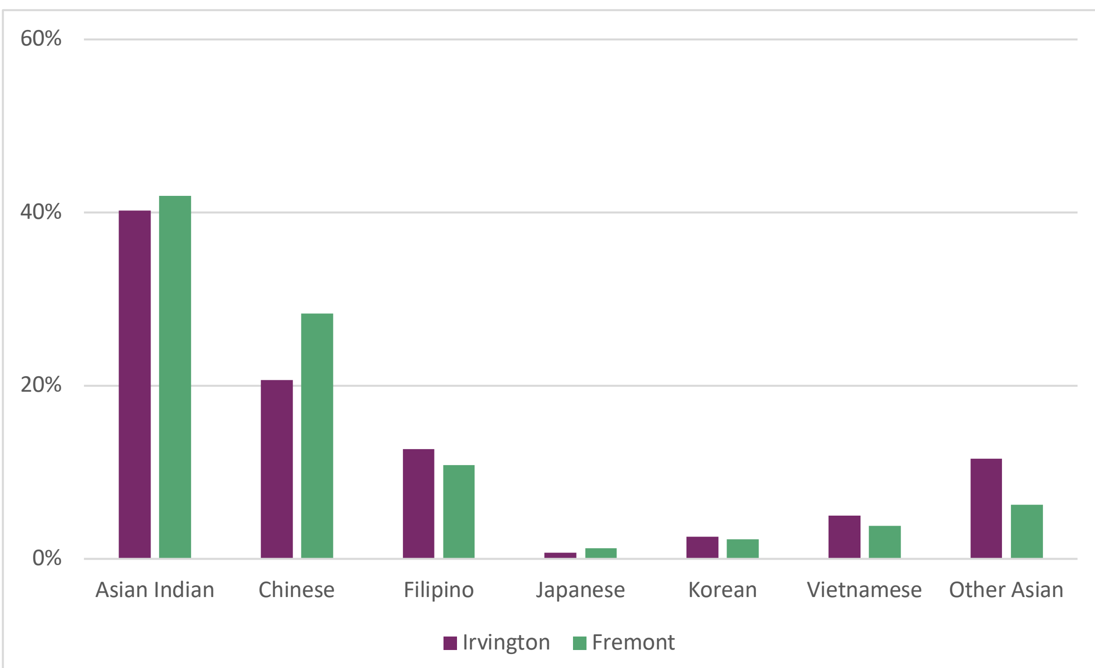


Figure 1.4: Breakdown of Asian Race in Fremont and Irvington (2019)

The change in ethnic and racial makeup of the City also reflects a diversity of languages spoken, with 63 percent of the population speaking languages other than English at home. In the Irvington District, this percentage is slightly higher at 65 percent non-English speaking households. Figure 1.5 highlights the percent of English-speaking households which are comparatively lower at 37 and 25 percent respectively for Fremont and Irvington District (US Census Bureau, n.d.).

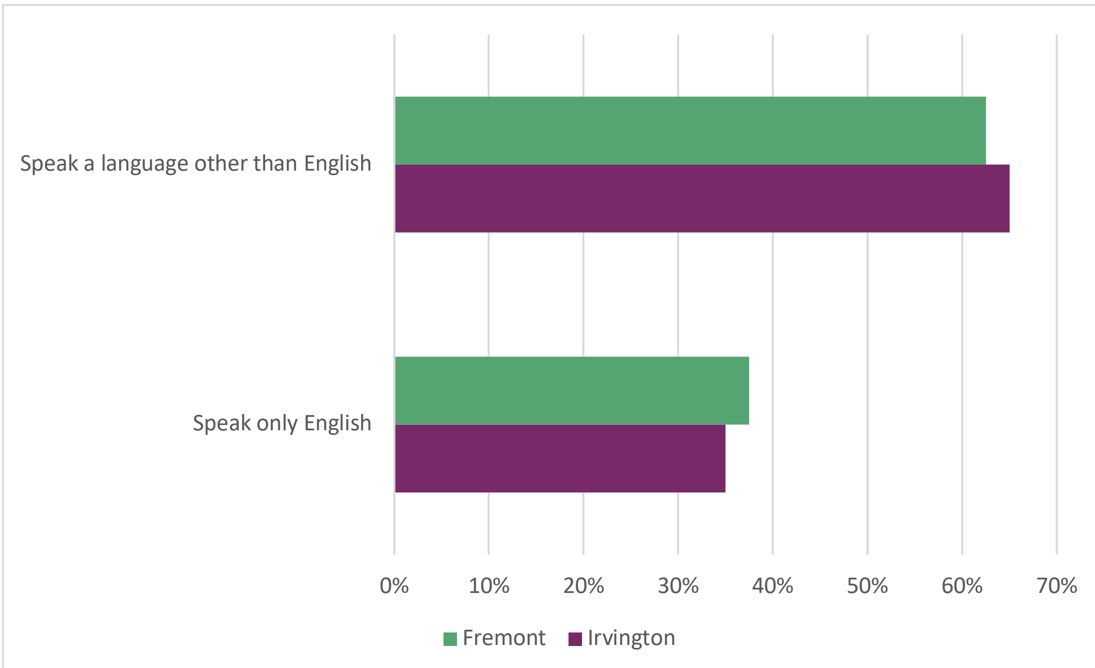


Figure 1.5: Languages Spoken at Home in Fremont and Irvington (2019)

Youth and Seniors

Like its Tri-City counterparts, a large share of Fremont's population is between the ages of 18 and 64, with the median age at 38.3 years. A more detailed breakdown of the population by age is shown in Figure 1.6 (US Census Bureau, n.d.).

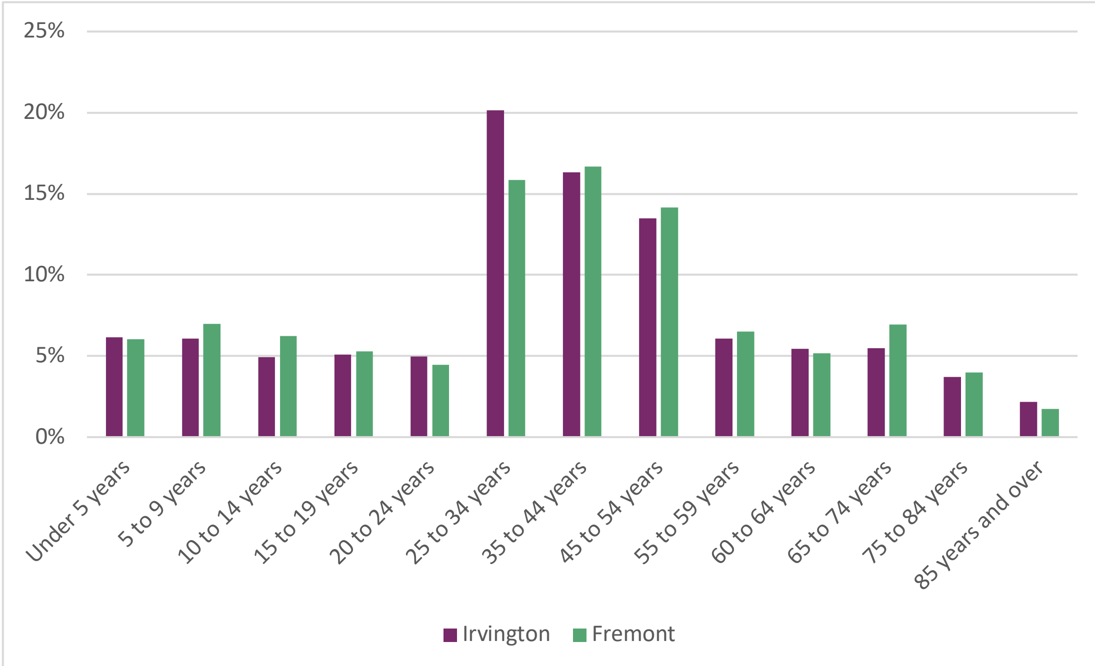


Figure 1.6: Age Breakdown of Fremont and Irvington (2019)

Income and Poverty

The median household income for the City of Fremont is $133,354, approximately $20,000 higher than its Tri-City counterparts. Intuitively, the poverty rate of 4.3 percent, is also lower in Fremont than in Newark and Union City by 0.2 percent and 0.7 percent respectively. However, it is important to take note of the disparities in incomes for men and women (US Census Bureau, n.d.). While the median income for men is $102,587, the median income for women is $73,603. Although the median earnings for women is higher than the national average of $43,022 in the same category, it is considerably low than the median salary for men in the area (US Census Bureau, n.d.).

The household income also differs from one racial group to another. In both Fremont and the Irvington District, the incomes of Asian households are higher than individuals of other races. The lowest median income in the City is for the American Indian and Alaska Native population at $80,841 per year while the lowest in the Irvington District is for Native Hawaiian and Pacific Islanders at $77,813 per year. Figure 1.7 shows the differences in median income for all races identified (US Census Bureau, n.d.).

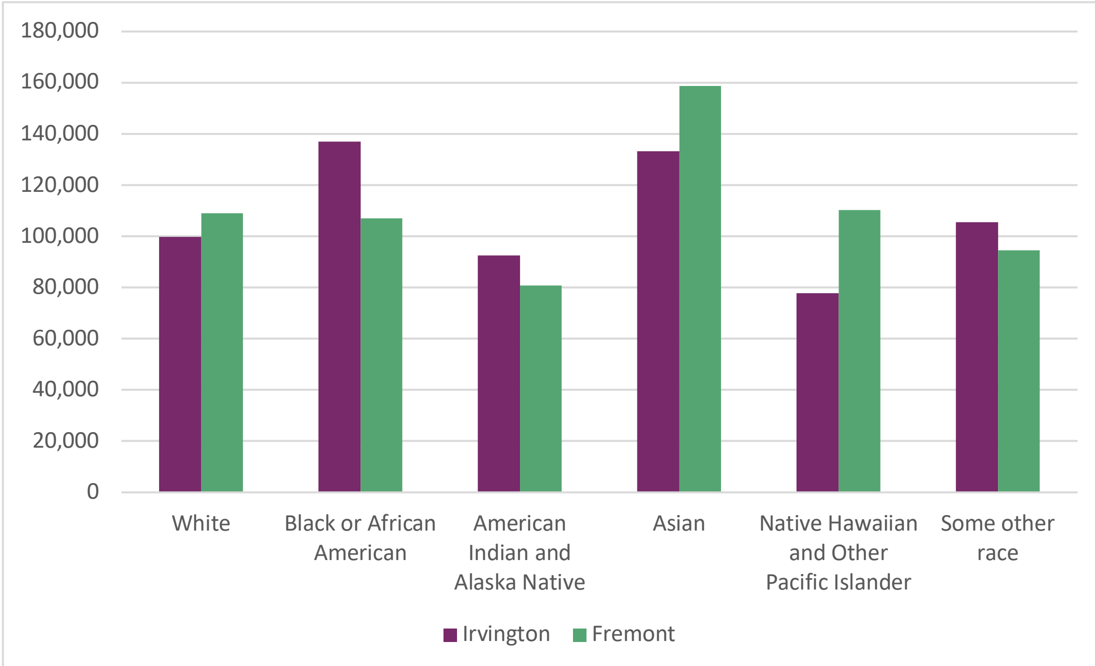


Figure 1.7: Median Income by Race in Fremont and Irvington (2019)

Vehicle Ownership

Fremont is an auto-dependent city – as of 2016, there was an average of 2.12 vehicles recorded per household, which is higher than the national average of 1.8 vehicles per household for the same year. As of 2019, Only 5 percent of households in the City were carless or owned no private vehicles (City of Fremont). In Irvington, this percentage was slightly higher with approximately 7 percent of the households not owning any vehicles. Most households in the City as well as within the Irvington context own at least 2 cars. A more detailed breakdown of vehicle ownership is highlighted in Figure 1.8 (Governing, 2014).

Figure 1.8: Vehicle Ownership Statistics for Fremont and Irvington (2019)

As the population of the City has increased in the last decade, so has the demand for parking. Due to the abundance of cars and lack of parking in many residential neighborhoods, cars are sometimes seen parked by curbs painted red that are reserved for emergency vehicles and fire trucks. Increasingly, more vehicles are seen parked across entrances to driveways and curb-cuts and sometimes blocking crosswalks, creating significant hazards for pedestrians with mobility challenges (North Fair Oaks).

Households and Tenure

In 2010, Fremont had just over 71,000 households, with approximately 65 percent being owner occupied and the remaining being renter occupied. In present day, around 61 percent of homes are owner-occupied in the City while about 48 percent are owner-occupied in the Irvington District. Immigrants, single individuals, and young adults living in the area choose to live in rented apartments as the $1.2 million homes in the area are too expensive to purchase (US Census Bureau, n.d.).

Figure 1.9: Home Ownership Statistics for Fremont and Irvington (2019)

Commute

A primary influence on commuting is the relationship between where people live and where they work. This relationship has become an increasingly important issue regionally as the spatial mismatch between jobs and affordable housing is causing growing numbers of workers to reside further from their workplaces. This trend is evident with large numbers of commuters traveling daily from housing in Fremont, Newark, and Union City to jobs in Oakland, San Jose, and San Francisco. Commuting between these cities continues despite a relative jobs-housing balance (City of Fremont, 2011).

Commuting data for the City of Fremont suggests an increase in the number of commuters to the cities of Oakland and San Francisco. Increasingly, more residents in the community are relying on public transportation for travel including buses and BART that has lines running through primary job locations. However, the use of private vehicles for commuting purposes remains the most common mode of travel as reflected in Figure 1.10. Approximately 81 percent of the residents of Fremont and Irvington prefer to drive to work while about 10 percent use public transit services in the area (US Census Bureau, n.d.).

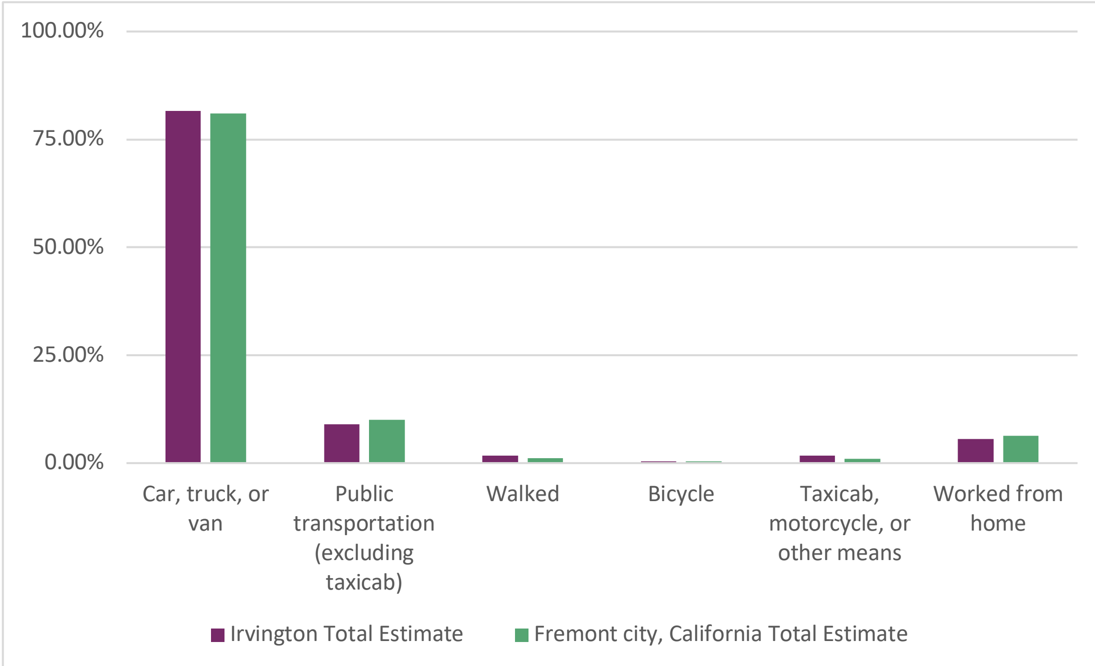


Figure 1.10: Means of Transportation to Work for Fremont and Irvington (2019)

Mobility Conditions

A city is both dependent and constrained by its transportation network. The proper construction and maintenance of roads, railroads, transit services and mobility infrastructure help facilitate the movement of residents and goods through a community. A well-developed transportation system therefore promotes the growth, vitality, and health of a city (Urban Systems, 2014).

Travel needs within the City of Fremont are met by a range of transportation facilities and services which connect the City's various districts to the rest of the region (City of Fremont, 2018). The existing transportation system is comprised of its street and highway network, public transportation services and pedestrian and bicycle facilities. Figure 1.11 shows the Regional Transportation Facilities in and around Fremont (City of Fremont, 2011).

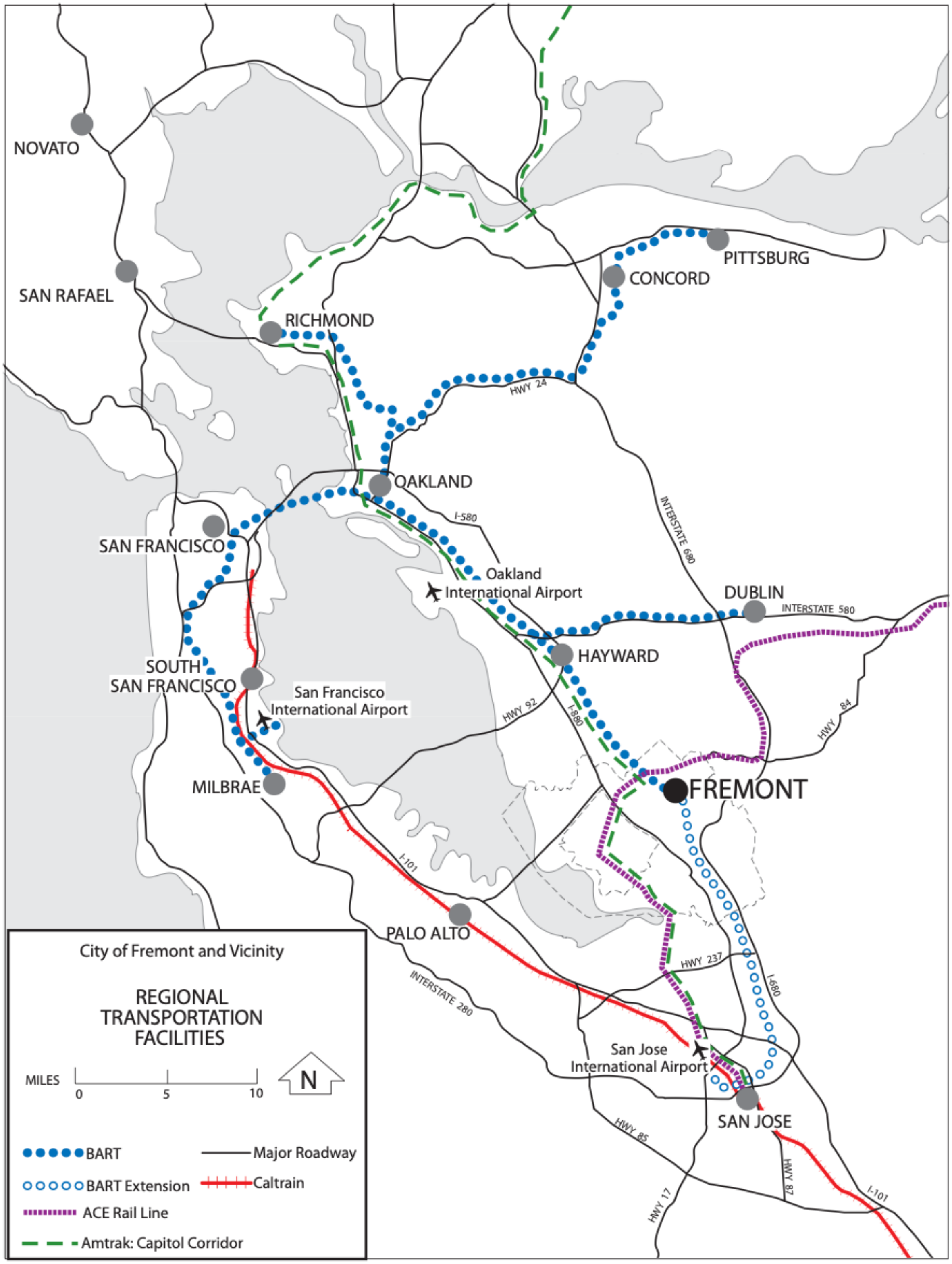


Figure 1.11: Regional Transportation Facilities (City of Fremont, 2011)

Street and Highway Network

Interstate Freeways

The most widely used freeway running through the center of Fremont is Interstate 880 or I-880 which connects the City of San Jose in the south to the City of Oakland in the north. Although the increased traffic congestion between the US 101 and California State Route 84 (Dumbarton Bridge) causes a funneling affect near the Fremont exits, this freeway is popularly used for commute purposes to crowds heading north and south (Interstate Guide).

Running parallel to I-880 near the southern edge of Fremont is Interstate 680 (I-680) which connects San Jose to Walnut Creek, Pleasanton, and Livermore (Interstate Guide). Unlike I-880, I-680 is more popularly used to travel south towards San Jose than traveling north towards Sunol which is primarily residential. Both I-880 and I-680 run north-south and have posted speeds of 65 miles per hour (mph).

State Highways

The primary state route in this region that connects East Bay to the cities of Menlo Park, Palo Alto and Redwood City is State Route 84. This two-laned bridge is widely used for commute but also provides direct access into Silicon Valley and popular tech companies like Facebook, Google, Apple, and Microsoft. Posted speeds are between 60 and 70 mph (California AA Roads).

Within the northern portion of the City limits is California State Route 238 (CA 238) which provides a short connection between I-880 and Interstate 580 (I-580) leading into Oakland in the north and Castro Valley and Pleasanton to the northeast of Fremont (California AA Roads).

Arterials

There are two categories of arterials serving the residents of Fremont, primary and minor arterials. Primary arterials like Mowry Avenue, Fremont Boulevard, Peralta Boulevard and Paseo Padre Parkway transport large volumes of traffic across town in both north-south as well as east-west directions. They connect the City of Fremont to its Tri-City counterparts, along with many employment and shopping hubs in the vicinity (City of Fremont, 2018).

Minor arterials in the City include roads like Central Avenue and Grimmer Boulevard that serve similar purposes as primary arterials but do not support as heavy of traffic volumes. Blacow Road, the focal point of this study, is also categorized as a minor arterial (City of Fremont, 2018).

Collectors

Collector streets which are a hybrid between arterials and local roads include roads like Roberts Avenue and Farwell Drive in Fremont. They stem into private parcels but also serve as low to medium volume streets connecting high-volume streets like Blacow Road to low-volume streets like Sherwood Street (City of Fremont, 2018).

Local Roads

Local streets in Fremont provide access to residential neighborhoods, some elementary and middle schools and small-scale retail/commercial type developments (City of Fremont, 2011).

Public Transportation Services

The effectiveness of a public or mass transit system depends on geography, spatial and land use decisions in that the service must be convenient to residential and employment centers, and in the case of this study, to educational establishments such as Irvington High School. Mass transit can reduce congestion and pollution or help offset some of the demand created by automobiles, be a more cost-effective method of travel (through the reduction of road construction), and sometimes serve as the only means of transportation for certain sects of the population. The City of Fremont offers various bus routes as well as railway connections between destinations both within and outside the City (City of Ferndale, 2016).

Bus Routes

The Alameda-Contra Costa Transportation District (AC Transit) and Santa Clara Valley Transportation Authority (VTA) operate buses which travel in and through the City of Fremont. Since the operation of the Milpitas/Berryessa BART station, Express 181 – the only VTA connection in the City – has been discontinued. Table 1.1 lists all active AC Transit routes serving the City. The maps for bus routes running through the Irvington District can be found in Appendix A (City of Fremont, 2018).

Meanwhile, various Paratransit services and programs are available for the residents of the City. Under the City of Fremont Paratransit Program, individuals can request door-to-door and group trip accommodations within the Tri-city Area. East Bay Paratransit also offers wheelchair-accessible transportation to those who need assistance. While the Paratransit Program is a community run initiative, services provided by the East Bay Paratransit organization require paperwork and service certification (City of Fremont, 2011).

Table 1.1: AC Transit Lines Serving the City of Fremont

Bus Line	Streets Covered
99	Mission Blvd – Decoto Rd – Fremont Blvd
200	Decoto Rd – Newark Blvd – Mowry Ave
210	Fremont Blvd – Mission San Jose
212	Fremont Blvd – Pacific Commons
216	Niles Blvd – Stevenson Blvd – NewPark Mall
217	Mission San Jose – Milpitas
232	Mission Blvd – Decoto Rd – NewPark Mall
239	Grimmer Blvd – Warm Springs Blvd
251	Paseo Padre Pkwy – Thornton Ave – Cherry St

Rail

BART lines in the area offer three stops within the Tri-City Area – Union City, Fremont and a newly added Warm Springs station that serves the southern edge of the City. As of February 2021, the organization is hoping to add another station between the Fremont and Warm Springs stops which will serve the Irvington area specifically. These trains which run from 5 am till midnight offer an affordable way to get to and from cities like Oakland, Berkeley, and San Francisco which are prime employment hubs for those residing in this part of the Bay (City of Fremont, 2018).

An Amtrak line runs through the center of Fremont and connects San Jose, Santa Clara, and Fremont over the bay. However, the fares are more expensive, and the trains are not as frequent as the BART lines which run every 7 or 12 minutes depending on peak travel times (AM and PM) (City of Fremont, 2018).

Figure 1.12: BART Service Map

Pedestrian and Bicycle Networks

Pedestrian and bicycle facilities play a vital role in a city's transportation environment. The non-motorized transport (NMT) system is comprised of facilities that promote mobility without the aid of motorized vehicles. A well-established system encourages healthy recreational activities, reduces travel demand on city roadways, and enhances safety within a livable community. Pedestrian and bicycle facilities also provide access to and from transit stops. Good transit access can furthermore increase the use of non-auto travel modes (Neighborhood Scout).

Pedestrian Network

Fremont residents depend on sidewalks and trails for recreation and as safe routes to and from school, work, and home. Although sidewalks are widely accessible in many parts of the city, particularly in the downtown area near the Fremont BART Station, there are gaps in the system which decrease connectivity and walkability within and in between the five districts. The Draft Pedestrian Master Plan from 2016, identifies potential projects in the area, many of which are focused on widening sidewalks and painting continental crosswalks across parts of town (Alta Planning & Design).

Within certain parts of the City, pedestrians must walk on roadway shoulders where available. This poses safety concerns and reduces the likelihood for pedestrian travel. Pedestrian routes within close proximity to school zones are especially important to the pedestrian network for a variety of reasons:

1. School children are often unsupervised and are unfamiliar with driving regulations and stopping speeds;

2. Peak hours of school traffic (especially the am peak) often coincide with typical peak hour drive times for non-school related activities like work commute;

3. Neighborhoods surrounding school zones are often established prior to school construction and are not designed to accommodate pedestrians; and,

4. Many schools lack a coordinated plan to separate walking trips from driving trips (City of Ferndale, 2016).

In some parts of Fremont, pedestrian trails serve a similar purpose as adjacent sidewalks. The Pedestrian Master Plan anticipates that sidewalks may be incorporated into the trail network and vice versa, to avoid redundancies and increased maintenance costs, provided that American Disability Act (ADA) accessibility requirements are met.

Bicycle Network

The existing bicycle facilities in Fremont consist of a combination of Class I, Class II and Class III. Figure 1.13 distinguishes the bikeway classifications between grades I through III. There is a fourth classification termed a Class IV bikeway. This is a buffer-separated or barrier-separated bike facility that runs alongside vehicular traffic lanes and is typically painted green; there is only one Class IV bike facility in Fremont which is in the Centreville District. The grade of a bicycle lane depends on the degree of separation between the bicycle lane and the vehicular right-of-way (Fehr & Peers, 2018).

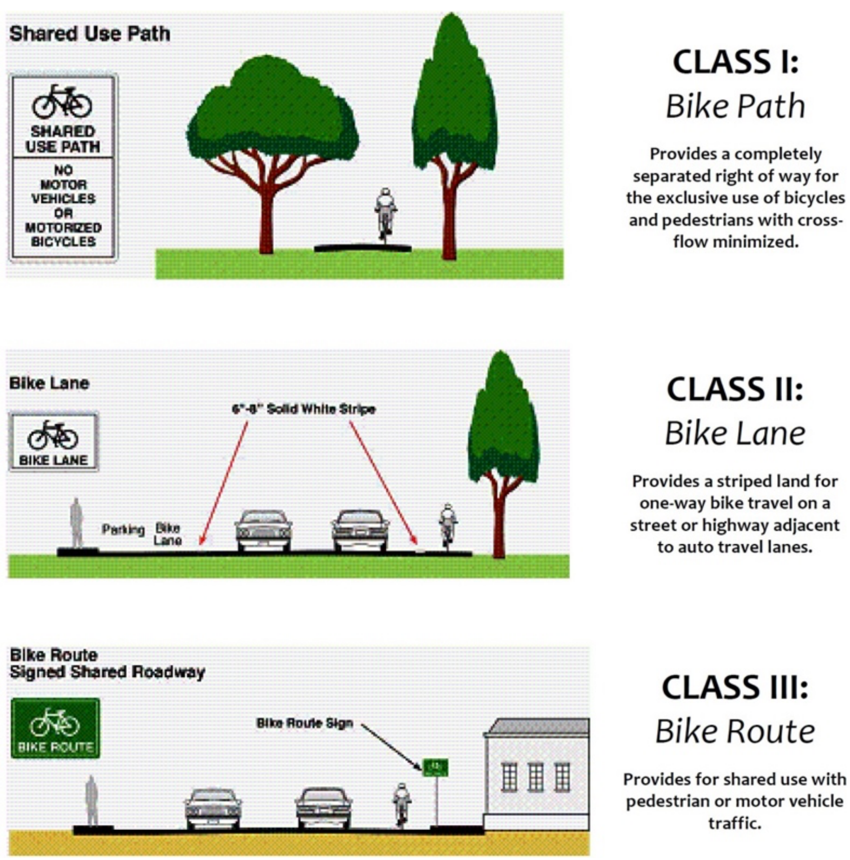


Figure 1.13: Bikeway Classifications

Irvington predominantly has Class II and III bikeways. These facilities are currently limited to primary and minor arterials and are yet to be extended to collectors and local roads. The locations of each bicycle facility are mapped in Figure 1.14. There are several shared bike routes, either between bicycle and pedestrian traffic or between vehicular and bicycle traffic (Fehr & Peers, 2018).

While pedestrian facilities like proper sidewalk infrastructure are intended primarily for shorter trips and may be significantly impacted by weather, season, and time of day, a robust bicycle network may provide a reasonable alternative to driving within the city limits. The Bicycle Master Plan adopted in 2018 identifies several low, medium, and high-priority bicycle corridors based on bicycle count data. Several projects in the downtown area have been constructed as of 2019 while many others are waiting for approval (Fehr & Peers, 2018).

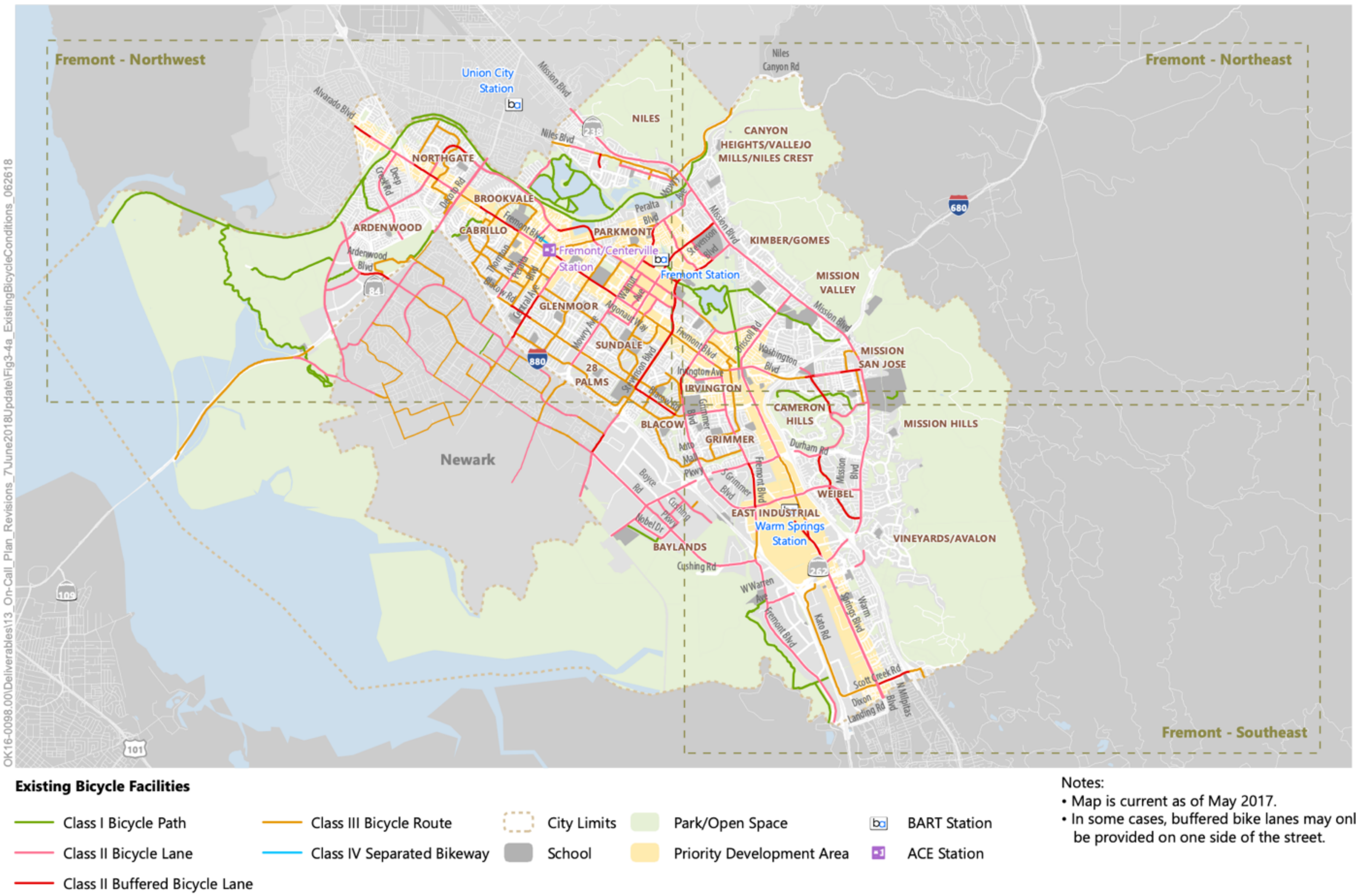


Figure 1.14: Existing Citywide Bicycle Network (Fehr & Peers, 2018)

CHAPTER 2

PROBLEM DEFINITION

As Fremont continues to expand and more people depend on private vehicles and drive-alone commutes, the transportation challenges become more dire. These setbacks have disproportionate impacts near schools where traffic congestion is higher and vehicle circulation is most sensitive. Meanwhile, providing active transportation infrastructure like well-connected sidewalks and wide bicycle lanes can offset these issues while providing the residents of a community with alternative modes of travel (like walking and bicycling). However, a small segment of Blacow Road – a major connection to and from Irvington High School – continues to face issues with congestion while also lacking proper street infrastructure that can be helpful near an educational establishment (Alta Planning & Design).

Traffic Congestion

In the meetings held for Irvington District's transportation plans and projects, residents and businesses identified traffic congestion (from pass-through and high school traffic) and circulation as the major issues facing the area. The stretch of Blacow Road between Fremont Boulevard and Grimmer Boulevard creates a funneling effect, where school commute traffic approaching from the east and west tend to slow down due to an increase of vehicular volumes (City of Fremont, 2018). The residential streets stemming from Blacow Road, especially Sherwood and Gatewood Streets, get backed up with vehicles trying to turn right or left, respectively, onto Blacow Road to access the school (City of Fremont, 2011).

Figure 2.1 introduces the street segment analyzed in this project and identifies the various problem areas. This stretch of Blacow Road has been divided into five segments (Figures 2.1.1 to 2.1.5) to provide a more detailed analysis of each subsection.

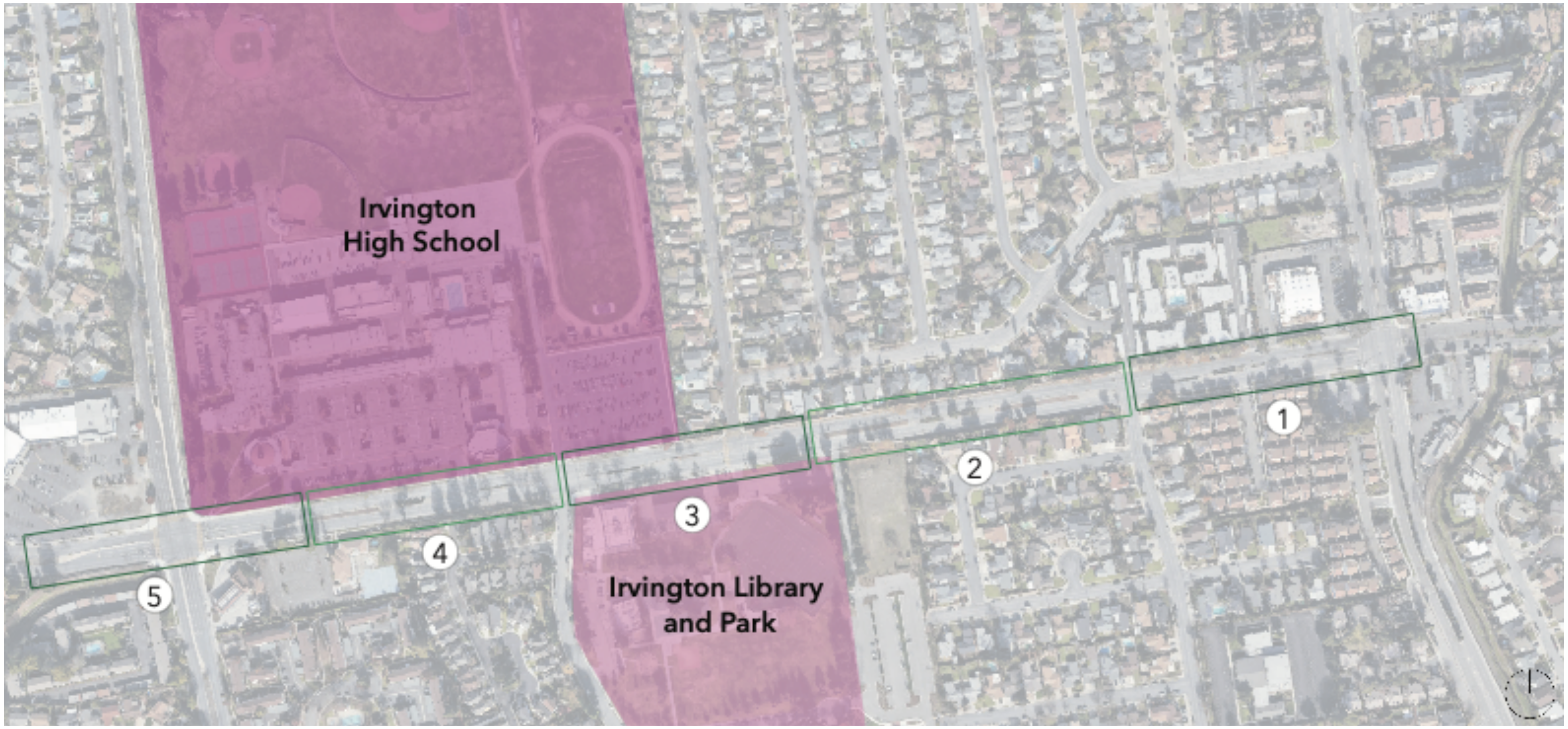


Figure 2.1: Blacow Road Bounded by Fremont and Grimmer Boulevards

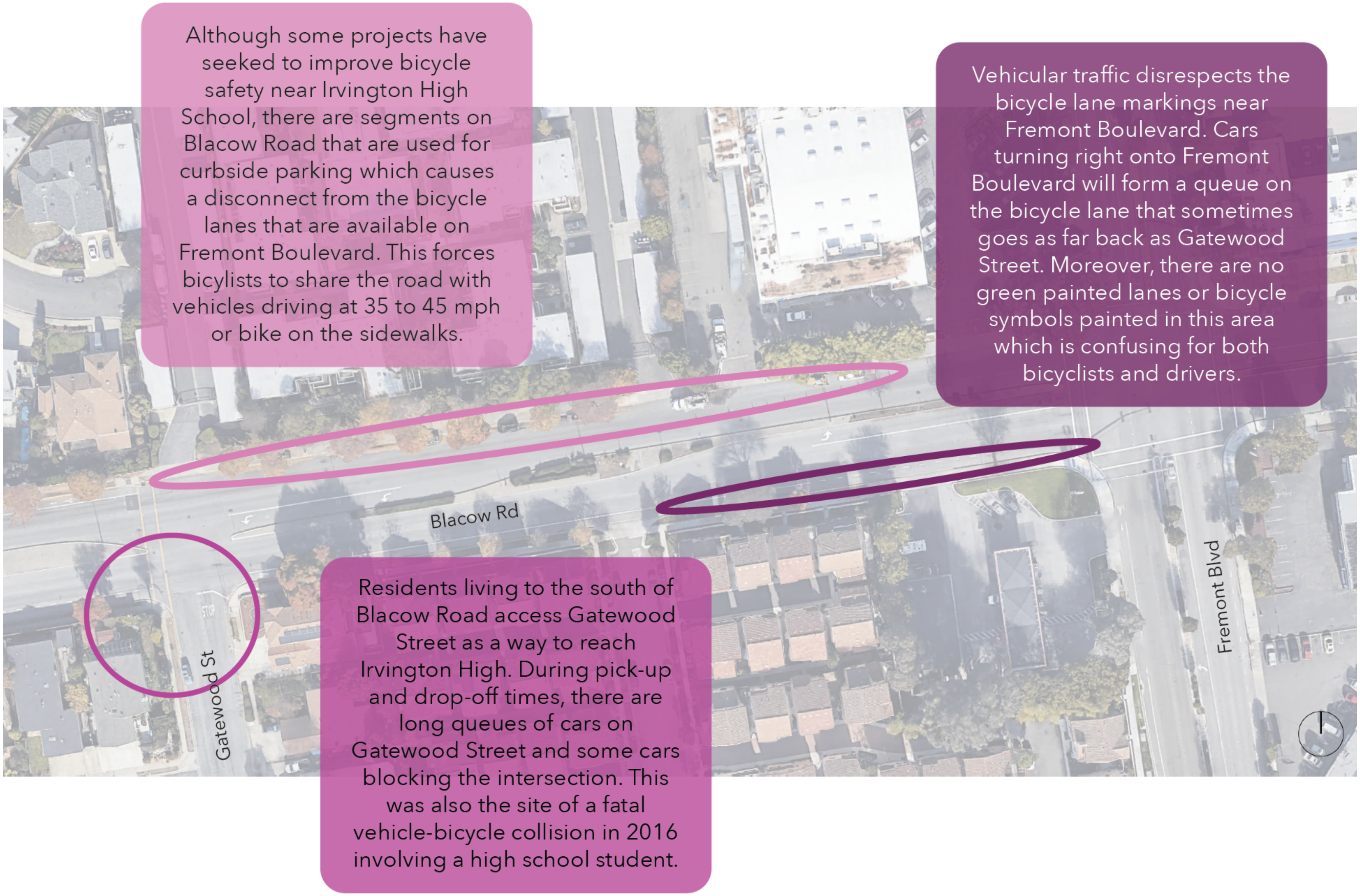


Figure 2.1.1: Blacow Road – Segment 1

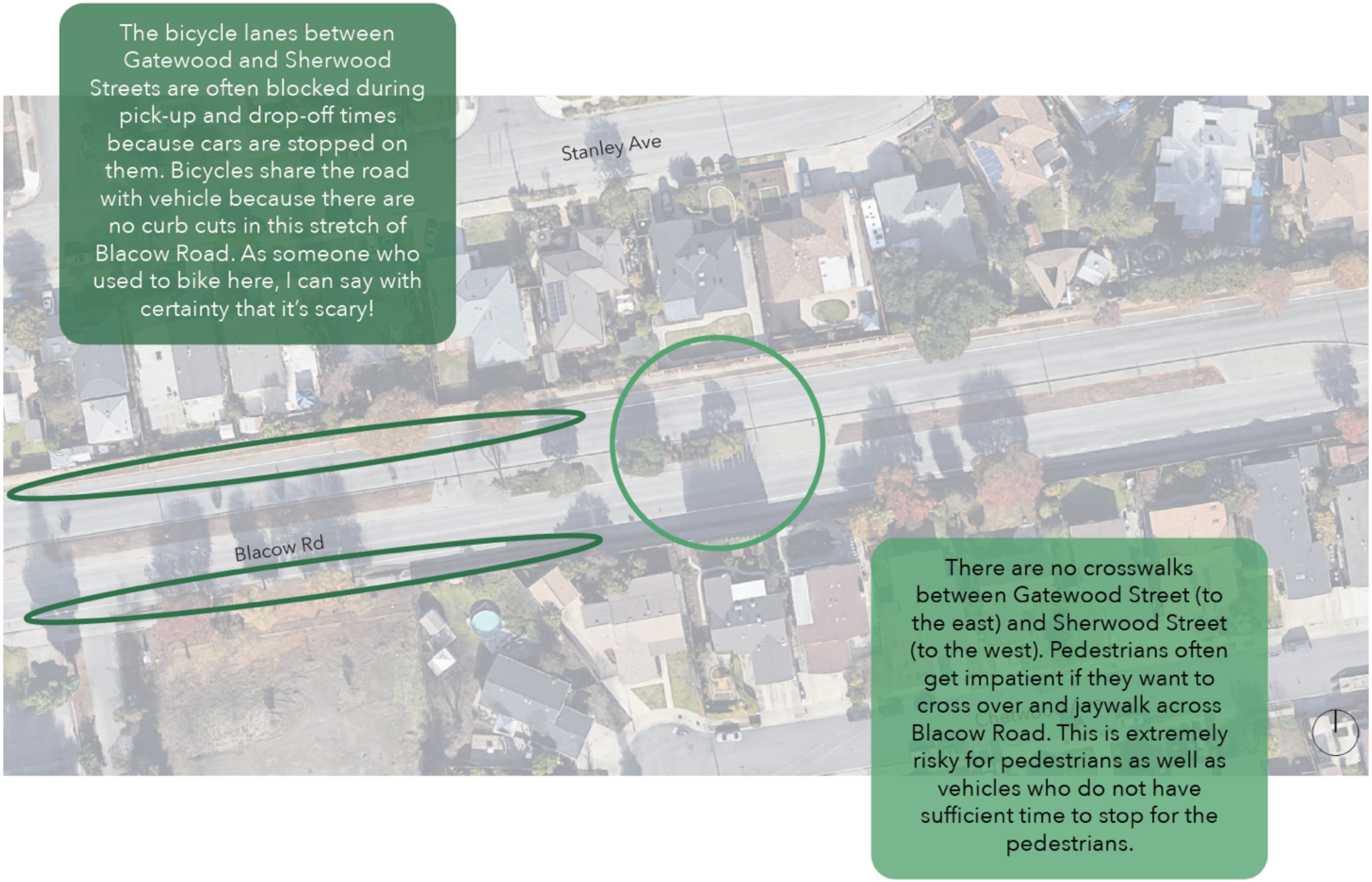


Figure 2.1.2: Blacow Road – Segment 2

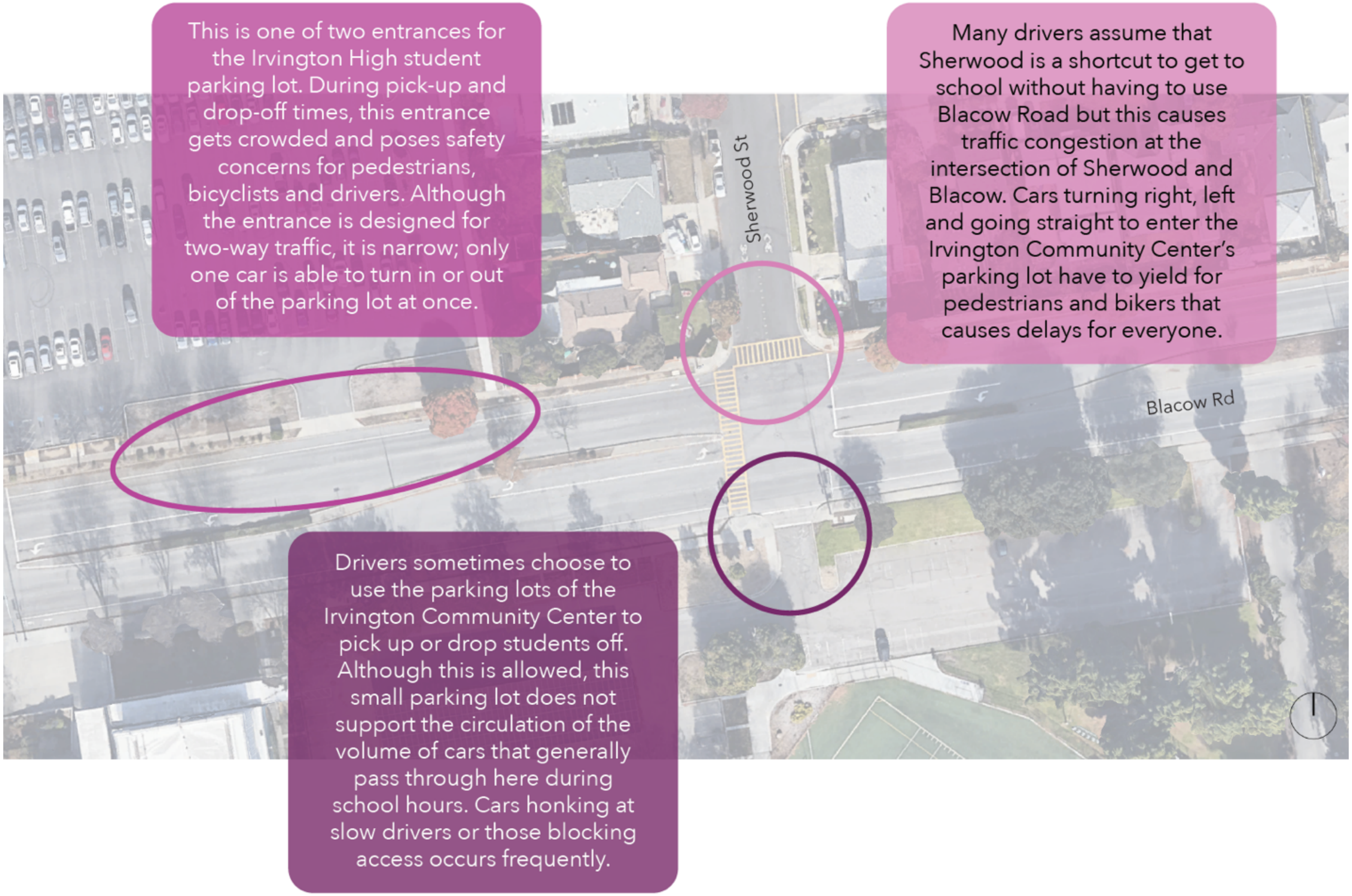


Figure 2.1.3: Blacow Road – Segment 3

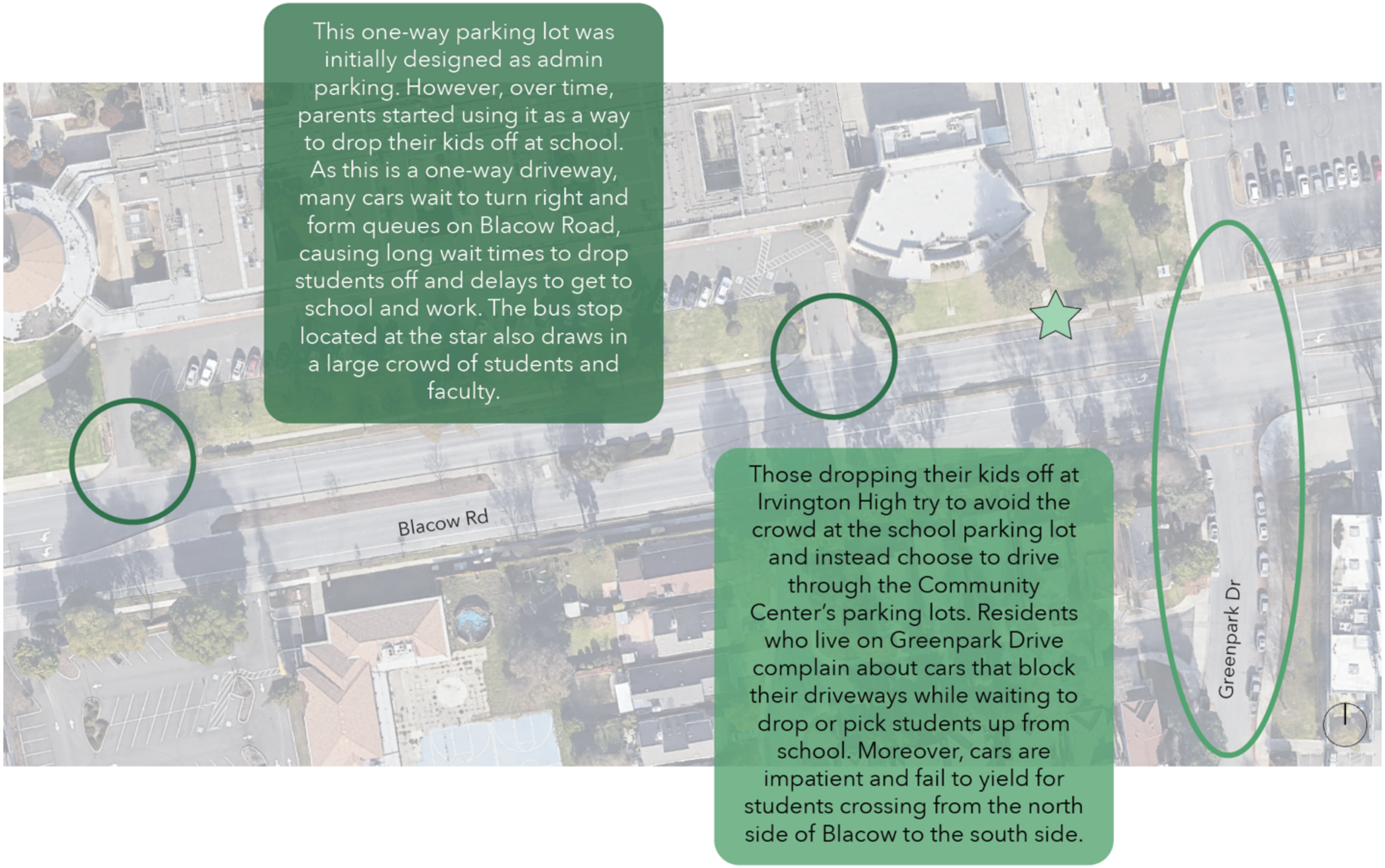


Figure 2.1.4: Blacow Road – Segment 4

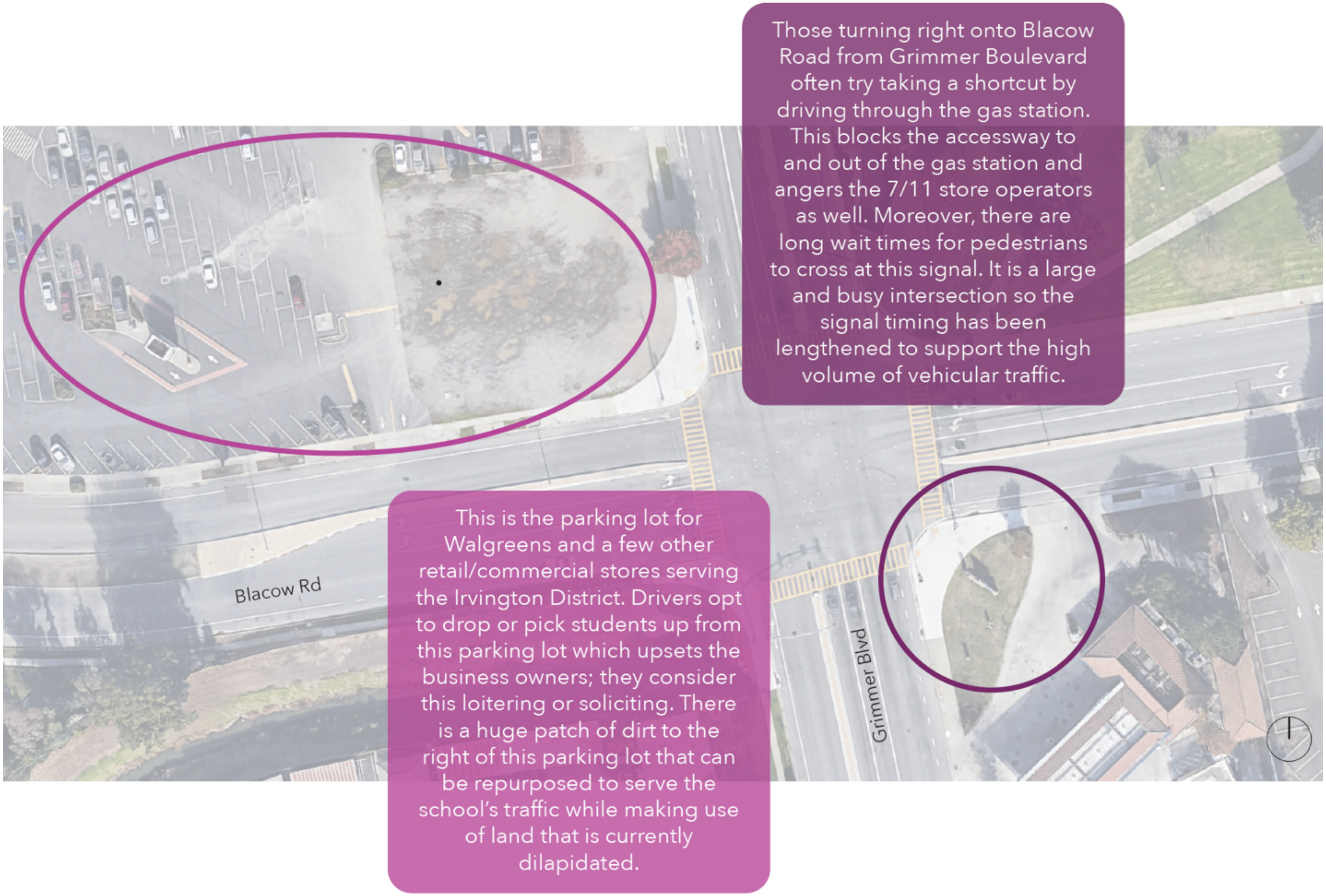


Figure 2.1.5: Blacow Road – Segment 5

Pedestrian Safety and Walkability

Many stretches of sidewalks in the Irvington District are in need of repair. Poorly lit, cracked, uneven and missing sidewalks present walking hazards for people of all ages, especially for children, seniors, and individuals with disabilities. Such conditions force the community residents to use the streets because sidewalks are in disrepair and are not wheel- chair accessible. Moreover, there is an insufficient number of pedestrian crossings on Blacow Road and near Irvington High School. Figure 2.2 captures the existing condition of sidewalks on Blacow Road, near Irvington High School (Alta Planning & Design).

Figure 2.2: Existing Sidewalks Conditions Near Irvington High School

Safety concerns in relation to walkability have been echoed by residents who live in the nearby communities as well as by concerned parents and family members who drop their children off at school. These concerns also reflect in the collision history data as measured by total vehicle-pedestrian collisions. The Pedestrian Master Plan adopted by the City of Fremont in 2016 studied the number of pedestrian-vehicle collisions in the City between the years of 2001 and 2015; more recent data is currently unavailable. Figure 2.3 shows the trends of such collisions in these fifteen years. Collisions fluctuated over the first decade of the period but between the years of 2011 and 2015, the collision count was steadily rising which is a cause for concern. However, compared to the bicycle safety issues detailed in the following section, the frequency and severity of pedestrian-vehicle collisions in the Irvington District, specifically within the project segment on Blacow Road, is lower (Alta Planning & Design).

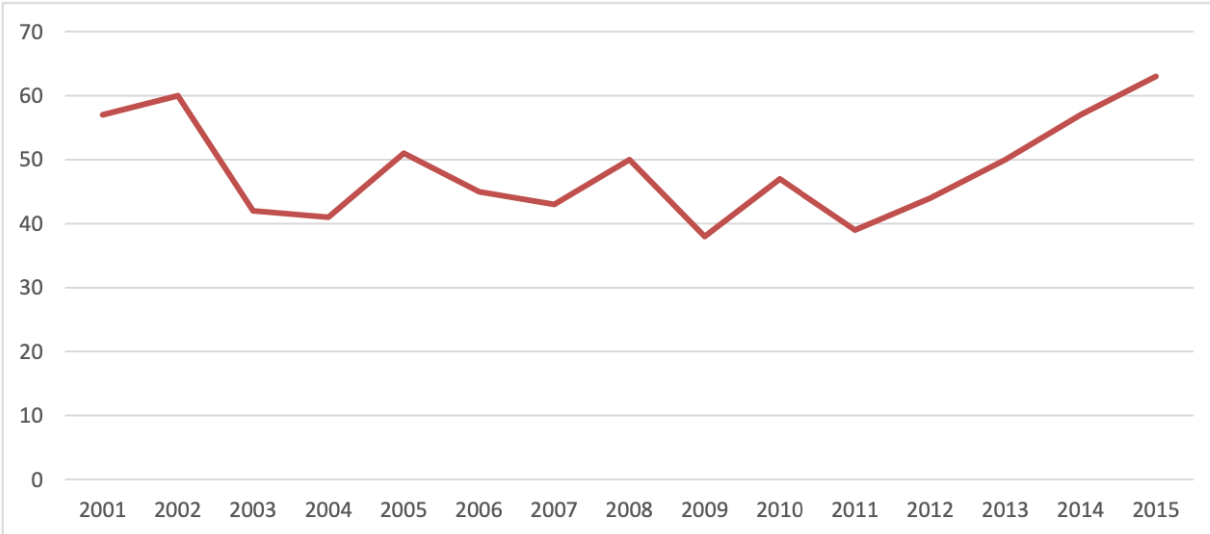


Figure 2.3: Pedestrian-Vehicle Collisions 2001-2015 (Alta Planning & Design)

Bicycle Safety

There are intermittent bike paths, routes, and lanes throughout Irvington District. As a result, a complete bike network does not yet exist. Uneven surfaces also present safety issues for students and faculty biking to and from school (City of Fremont, 2016). Residents and concerned citizens often mention the need for more flexibility for transporting bikes on buses and the need for more bike facilities, including wider bike lanes on Blacow Road and on nearby arterials like Grimmer and Fremont Boulevards. Where there are bicycle lanes, cars from nearby residential neighborhoods are parked on-street, occupying the bicycle lanes, and therefore making it challenging for bicyclists to continue using the bicycle lane (Fehr & Peers, 2018). Some of these issues have been captured in Figure 2.4.

Figure 2.4: Bicycle Lanes on Blacow Road, in and around Irvington High School

Bicyclists are among the most vulnerable roadway users and therefore are more susceptible to serious injury, even more so than pedestrians who typically utilize sidewalks and often do not share the road with vehicular traffic. Although Fremont is ranked favorably for bicycle safety overall, a significant percentage of the 185 bicycle-vehicle collisions recorded between the years 2012 and 2016 were in the Irvington District, specifically on Fremont Boulevard and Blacow Road which are two of the three top high injury bicycle corridors in Fremont (Fehr & Peers, 2018).

Intersections often present safety issues for bicyclists because of the frequency of cars changing lanes and turning across bicyclists' path of travel. Table 2.1 lists the locations where more than one bicycle collision was recorded in or near the intersection over the four-year period (Alta Planning & Design). The six intersections within the Irvington District are in green, bolded text.

Table 2.1: Locations with the Highest Frequency in Fremont (Alta Planning & Design)

Intersection	Number of Collisions
Blacow Road and Fremont Boulevard	3
Blacow Road and Omar Street	2
Blacow Road and Sherwood Street	3
Blacow Road and Stevenson Boulevard	2
Blacow Road and Thornton Avenue	2
Driscoll Road and Chiltern Drive	2
Fremont Boulevard and Carol Avenue	2
Fremont Boulevard and Sundale Drive	2
Palm Avenue and Wisteria Drive	2
Paseo Padre Parkway and Grimmer Boulevard	2

Inequity in Accessibility

The large volume of vehicles entering and leaving the high school during school drop-off and pickup times is one part of the problem; there is also an issue of accessibility in the area (Governing, 2014). Although students living in the Irvington District can walk or bike to school, the Irvington School District serves residents of the Warm Springs community to the south of Fremont. While there are several elementary and middle schools for students residing in this district, Irvington High is the only high school serving this area. Students who live further away are unable to walk or bike to school and in turn depend on cars or public transportation. Figure 2.5

shows the relative accessibility of the high school within 0.25-, 0.5- and 0.75-mile radii, where the center point is the entrance to the school (PedSafe, n.d.). Bottom line, not everyone who lives further away from school is able to drive and those who live nearby do not have the necessary facilities to feel safe while walking or biking to school (City of Fremont, 2018).

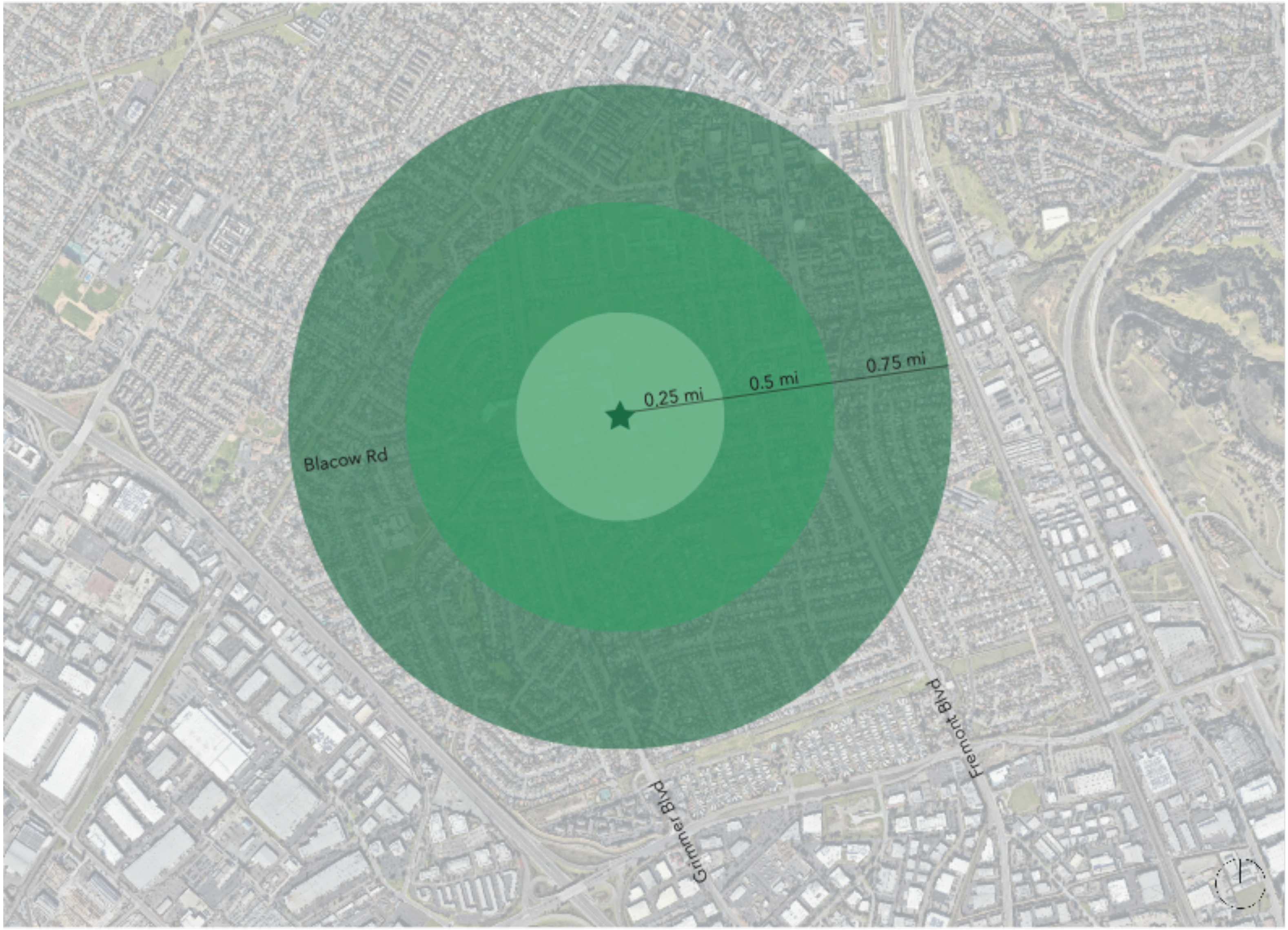


Figure 2.5: Accessibility Radii from Irvington High

CHAPTER 3

CASE STUDIES

Safety, accessibility, and mobility concerns identified in previous sections can be addressed using strategies that have developed over the last few decades. Planning techniques such as Complete Streets and programs like Safe Routes to School have become increasingly popular approaches to addressing transportation-related concerns in California and the rest of the United States. Projects under these initiatives typically aim to make communities and school surroundings walkable and bikeable while improving the flow and access of cars and transit (Placer County Transportation Planning Agency). This helps increase overall mobility while also reducing externalities such as traffic accidents and emissions of harmful pollutants; in addition, they often seek to improve connections to and from jobs, goods, and services for those who cannot afford to drive. These strategies, as well as precedents within each category, are explained in further detail in the following subsections (PedSafe, n.d.).

Complete Streets

Complete Streets policies are designed to encourage cities develop road networks that are safer, more livable, and accessible. Under this principle, road infrastructure is designed to accommodate all users including motorists, pedestrians, public transit users and bicycle riders of varying ages and abilities (The Aspen Institute, 2017). Complete street initiatives, as the name suggests, help to create streetscapes that serve more than just motor vehicles. As people become more aware of the environment and the harmful impacts that car culture presents, they begin to understand that complete streets' policies can help encourage a healthy lifestyle and can therefore create more viable communities (Metro).

One of the guiding principles of a "complete street" is the idea that all modes of transport have equal importance in roadway design. This pushes planning agencies and local governing bodies to plan for appropriately spaced and properly sized bike lanes, wide sidewalks, sufficient transit stops and bicycle parking. In this sense, they promote active living, establish better road systems, and allow for safer travel via active transport (Mobility Solutions for Environmental Justice Communities, 2016). Over the last decade, several cities and counties across the United States have adopted policies ranging from community-wide initiatives to roadway engineering updates to state-wide policies which have sought to incorporate complete street design principles into their plan and project proposals. One such city is Grand Rapids, Michigan that implemented their Vital Streets Plan in 2016 to "achieve the envisioned complete streets outcome for safe, accessible, attractive and multimodal streets that serve all people and improve the livability and economic prosperity of [their] great city" (Nelson\Nygaard, 2016).

Grand Rapids, Michigan

Grand Rapids, Michigan is a city that has grown extensively over the last decade. The city's job growth and smart growth principles have led it to be labeled one of the most successful and sustainable cities in the country. One of its many initiatives to integrate green infrastructure into the city's landscape is the Vital Streets Plan adopted by the City Commission in 2016 (Nelson\Nygaard, 2016).

This effort began in 2013 when the City of Grand Rapids appointed a Sustainable Streets Task Force to identify streets in the city which required maintenance. Their report highlighted that over 60 percent of the streets needed repair and would need to be reconstructed or improved in the near future. As a starting point, the city developed recommendations that would vitalize street space not just for the vehicles on the road but also for pedestrians and bicyclists. The Task Force also decided on incorporating green infrastructure which would liven the streetscape of Grand Rapids. The vision for Vital Streets is as follows:

"The network of city streets and rights-of-way will be accessible, attractive, multimodal and safe; serving all people of our community, contributing to the livability of our neighborhoods and business districts, protecting the quality of our river, and increasing economic opportunity to individuals, businesses, and new development.

Infrastructure assets will be maintained and well-managed, using a multi-faceted funding and educational strategy and innovative approaches to preserve our investment"

- ***Vital Streets Plan*** (Nelson\Nygaard, 2016)

At the heart of developing street improvements was to document the types of streets that ran through the city. In the plan, the city categorized streets based on their typology, modes used, and transitions from one street type to another. Based on this system, the city was able to create a reference guide to highlight anticipated and desired uses, priority users, design features and treatments, and target metrics for each street typology (Nelson\Nygaard, 2016). For example, a neighborhood residential street was anticipated to promote recreational space for residents in the area. Therefore, a possible design feature identified was controlled crosswalks and narrow travel lanes to manage vehicular speeds and allow vehicles to yield to children at play. These guidelines allowed the city to create balanced streets that could easily be designed, maintained, and used by those who live, work, and play in the community (Nelson\Nygaard, 2016).

Figure 3.1: A Typical Residential Street in Grand Rapids, MI

Safe Routes to School

Safe Routes to School (SR2S) program is aimed at making bicycling and walking to school safe for school children in K-8th grades. The program aims to provide funds and services for infrastructure improvements as well as other initiatives for the education, encouragement, and enforcement of safe active transportation services near schools. Issues like traffic congestion, fuel consumption and air pollution near schools, coupled with growing health and obesity concerns, have led people to believe that walking and biking to school may be a low-cost and healthy alternative to using private vehicles (Safe Routes to School, 2019).

SR2S programs present a unique opportunity for a variety of individuals to partner and work towards a common goal. Through these programs, parents, school principals, school district officials, private school officials, local transportation officials and nonprofit organizations are encouraged to work together to create a safe way for children to walk and bike to and from schools. For this study, I have identified three cities within California that have implemented or are currently improving access to schools through SR2S initiatives (Safe Routes to School, 2019).

Palo Alto, California

Parents and community members of the City of Palo Alto, members of the Parent-Teacher Association (PTA) and City/School Traffic Safety Committee (CSTSC) have worked hard in ensuring that their children are able to walk and bike to school in the safest way possible. In cooperation with the city staff as well as school officials, the SR2S program in Palo Alto has been able to reverse the trend of using personal cars to get to and from school (City of Palo Alto, 2019). Students are motivated to walk, bike or carpool which have proven to be healthier alternatives to driving. The city has come a long way since 2003 when the SR2S initiatives first began. Today, roads near every elementary, middle, and high school have been improved to accommodate for relatively heavy pedestrian and bicycle traffic (City of Palo Alto, 2019).

Although there are two high schools serving the Palo Alto Unified School District, Palo Alto High School is the most like Irvington High in terms of its demographic makeup and the total school population. Figure 3.2 highlights the results of SR2S initiatives on and near Palo Alto High School for the 2019-2020 academic year. As shown in the charts and graphs in this infographic, approximately 76 percent of the students chose to commute to school using green transportation including walking, bicycling, scooter, bus, or carpool (City of Palo Alto, 2019). Unfortunately, these percentages are quite different for Irvington High where the split between green transport and private vehicle is 50/50. This is double the percent of students at Palo Alto High who use personal vehicles for commute (Fehr & Peers, 2018).

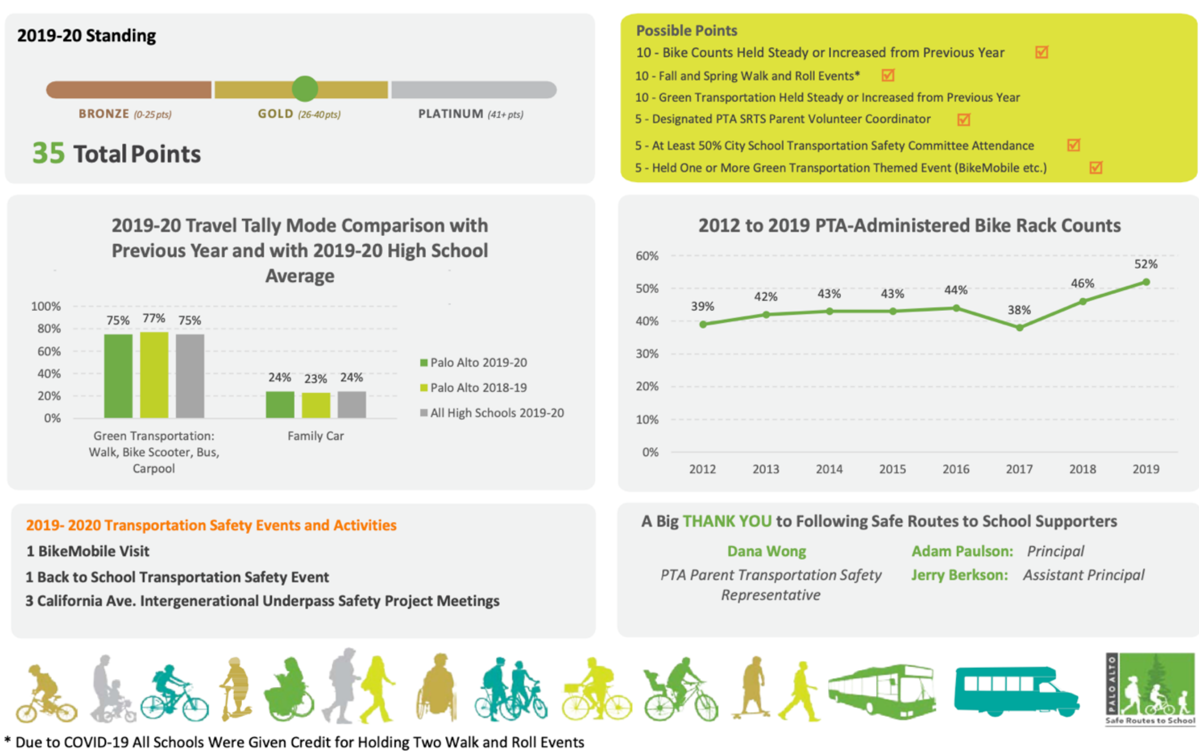


Figure 3.2: SR2S Snapshot of Palo Alto High School, AY 2019-2020

While the reasons for the differences in ridership data might be many, it is safe to say that the active transportation facilities offered near these schools have an impact on students' mode share patterns. Table 3.1 highlights the differences between the busiest intersections near Irvington High School and Palo Alto High School. There are notable differences in perceived safety and green infrastructure for pedestrians and bicyclists.

Table 3.1: Irvington High School v. Palo Alto High School

Irvington High School	Palo Alto High School
 *Blacow Road/ Greenpark Drive, Fremont*	 Churchill Avenue/ Castilleja Avenue, Palo Alto
Main entrance: located on a collector Crosswalk: yellow painted continental crosswalks on two major approaches; no crosswalks on other two Intersection: controlled on major approaches with the help of traffic signals Bike lane: green painted but narrow Pedestrian infrastructure: narrow to wide sidewalks available with no protective beacons; bus stop dominates pedestrian right-of-way Lighting: streetlights are available	Main entrance: located on a residential street Crosswalk: yellow painted continental crosswalks on all four approaches; flashing beacons on all four corners Intersection: a combination of stop-controlled and uncontrolled approaches Bike lane: not painted green on all streets; wider bike lanes Pedestrian infrastructure: wide sidewalks on all four sides with protective beacons on the northeast corner (close to the school) Lighting: no streetlights visible

Relevance to Study

Implementing some of the SR2S improvements near Palo Alto High School are deemed useful for those accessing Irvington High School daily. Some of these changes could include (Urban Systems, 2014):

1. Painting a yellow continental crosswalk across Blacow Road, from the east side of Greenpark Drive to allow an even distribution of students to cross the street from the south side of Blacow Road to Irvington High

2. Providing protective bollards for pedestrian rights-of-way such as sidewalks

3. Improving signal timing to allow more students to cross the street and to prevent cars from queuing on Blacow Road

4. Provide more than one entrance to Irvington High School (preferably from the back end of the school on Carol Avenue) to avoid overcrowding the front entrance

5. Move the bus stop to another location so as to avoid the interactions among multiple modes of travel, and reclaim the sidewalk for pedestrians

Fontana, California

The City of Fontana, California has incorporated a Safe Routes to School Toolkit in their Active Transportation Plan (ATP) which was adopted in 2017. This toolkit provides the city with ways to educate, encourage and empower the residents of Fontana to walk and bike safely to school. The programs listed in the ATP and put forth via SR2S complement one another and aim to increase safe walking and bicycling conditions within the community's school neighborhoods. SR2S programs leverage resources often commonly found in schools, such as walk to school day events, to establish programs that affect behaviors of individual students and the community (Alta Planning & Design).

Based on the recommended network presented in the ATP, the City of Fontana was able to identify strategies which can improve existing bikeways and help create new bike connections along school corridors. Table 3.2 elaborates these strategies.

Table 3.2: Strategies to incorporate new and/or improved bike lanes in Fontana, CA

Lane Narrowing
This technique uses road space that exceeds minimum standards to provide the needed space for bike lanes. While 10- or 11-foot-wide travel lanes are common, accommodating bicycle lanes, especially on urban arterial streets can narrow the travel lanes while still providing sufficient space for one or two lanes of traffic.

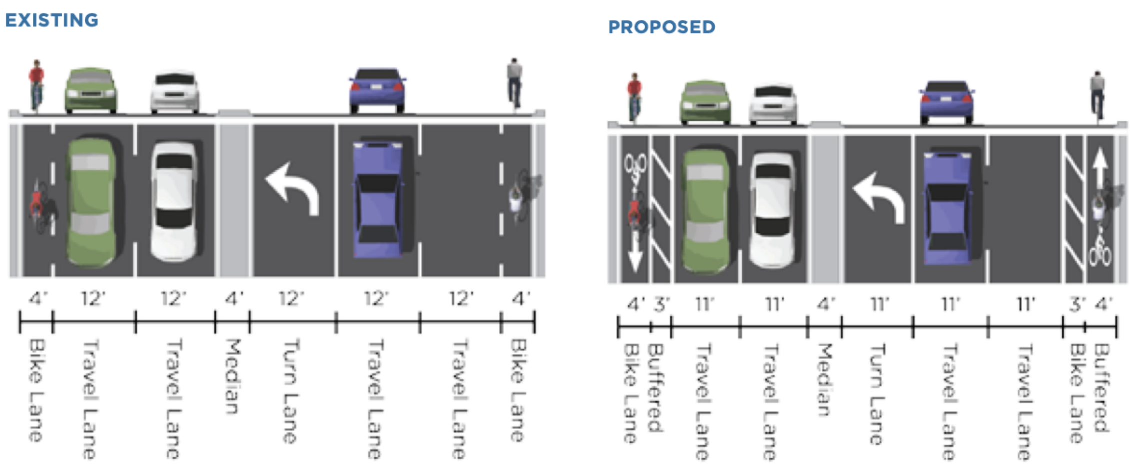


Image. City of Fontana ATP, 2017

Traffic Calming
This technique compels motorists to slow down and deters motorists from driving on a street that has been prioritized for biking and walking. Narrowing traffic lanes, speed tables, and roundabouts are some of many examples of potential traffic calming strategies that can be implemented near schools.

Road Rebalancing
Streets with excess vehicle capacity provide opportunities for bicycle lane retrofit projects. The repurposing of a single traffic lane can generally provide sufficient space for bike lanes on both sides of a street.

An important feature of the ATP was to identify potential Complete Streets and roadway infrastructure improvements that can be on different street typologies. The intersection of Hawthorne and Citrus Avenues was identified as a prime location for school-related infrastructure improvements (Alta Planning & Design). Figure 3.3 showcases the existing intersection and the proposed plan for the intersection. The study identified that curb extensions (also known as bulbouts), high visibility crosswalks or continental crosswalks and median refuge islands can increase visibility of students while making it safer for the students at Fontana High School to walk and bike.

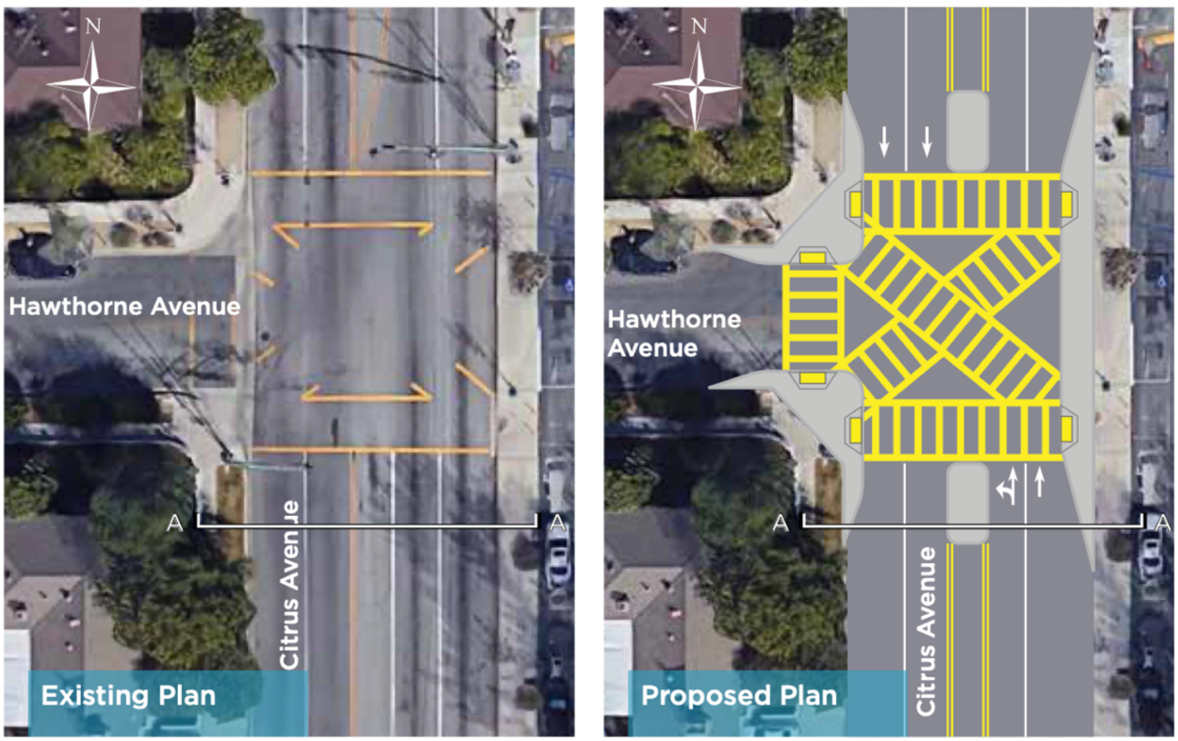


Figure 3.3: Potential Improvements on Hawthorne and Citrus Avenues in Fontana, CA

Relevance to Study

While the Palo Alto High School identified basic SR2S improvements at intersections, the Fontana ATP provides traffic engineering and roadway design changes than can promote a safer school community. The following takeaways from the Fontana ATP can also be incorporated into the Blacow Road Improvement Plan:

1. Creating simple renderings of potential intersection improvements can help the community as well as decision-makers visualize what the intersection could look like in the future

2. Providing more than just proper crosswalks is crucial; the roadway engineering should also support the use of active transportation

3. Altering lane geometry without decreasing traffic flow can help provide wider and more accessible bicycle and pedestrian infrastructure including wider sidewalks and bike lanes

Cupertino, California

Homestead Road located in Cupertino is a major east-west corridor that provides access to West Valley Elementary, Cupertino Middle School and Homestead High School. The Homestead Road Safe Routes to School Study, conducted in 2019, documented intersections which need improvements and put forth proposals to ensure safe access to school along this corridor (Kimley Horn, 2019). Like other SR2S studies, stakeholder and public involvement played a crucial role in determining project priorities. Using a series of engineering drawings, the plan was able to pencil out potential improvements for Homestead Road that would enable pedestrians and bicyclists to walk and bike near schools (Kimley Horn, 2019). An example of an engineering drawing is shown in Figure 3.4 on Page 44.

While traffic, roadway and engineering design concepts are important, funding is a rather important topic to cover. Unlike the previous two cities, the City of Cupertino along with neighboring cities and local agencies were able to create a table of probable costs. Table 3.3 has been pulled directly from the plan to use as a template for this study.

Table 3.3: Opinion of Probable Cost for Homestead Road Improvement

#	DESCRIPTION	QUANTITY	UNIT	COST / UNIT	TOTAL COST
1	Install Flashing Sign and Post at Homestead Road/Fallen Leaf Lane (very near term)	1	EA	$ 10,000	$10,000
2	Install Thermoplastic Pavement Marking	167	EA	$ 140	$23,380
3	Install Green Thermoplastic Pavement Marking	29,500	SF	$ 14	$407,100
4	Install Thermoplastic Striping	200,500	LF	$ 3	$553,380
5	Install Concrete Sidewalk	56,000	SF	$ 55	$3,091,200
6	Install Concrete Curb and Reconstruct AC Pavement	6,500	LF	$ 210	$1,365,000
7	Install Traffic Signal at Homestead Road/Fallen Leaf Lane	1	EA	$ 700,000	$700,000
8	Install Sign and Post	8	EA	$ 1,200	$9,600
9	Install Curb Access Ramps	44	EA	$ 14,000	$616,000
10	Modify Traffic Signal (Bernardo Avenue, Wright Avenue)	2	EA	$ 200,000	$400,000
11	Install RRFB at CMS	1	EA	$ 42,000	$42,000
12	Install Chainlink Fence	1,200	LF	$ 140	$168,000
				Total	**$7,385,660**
		Total Cost with Contingency (50%)			**$11,078,490**

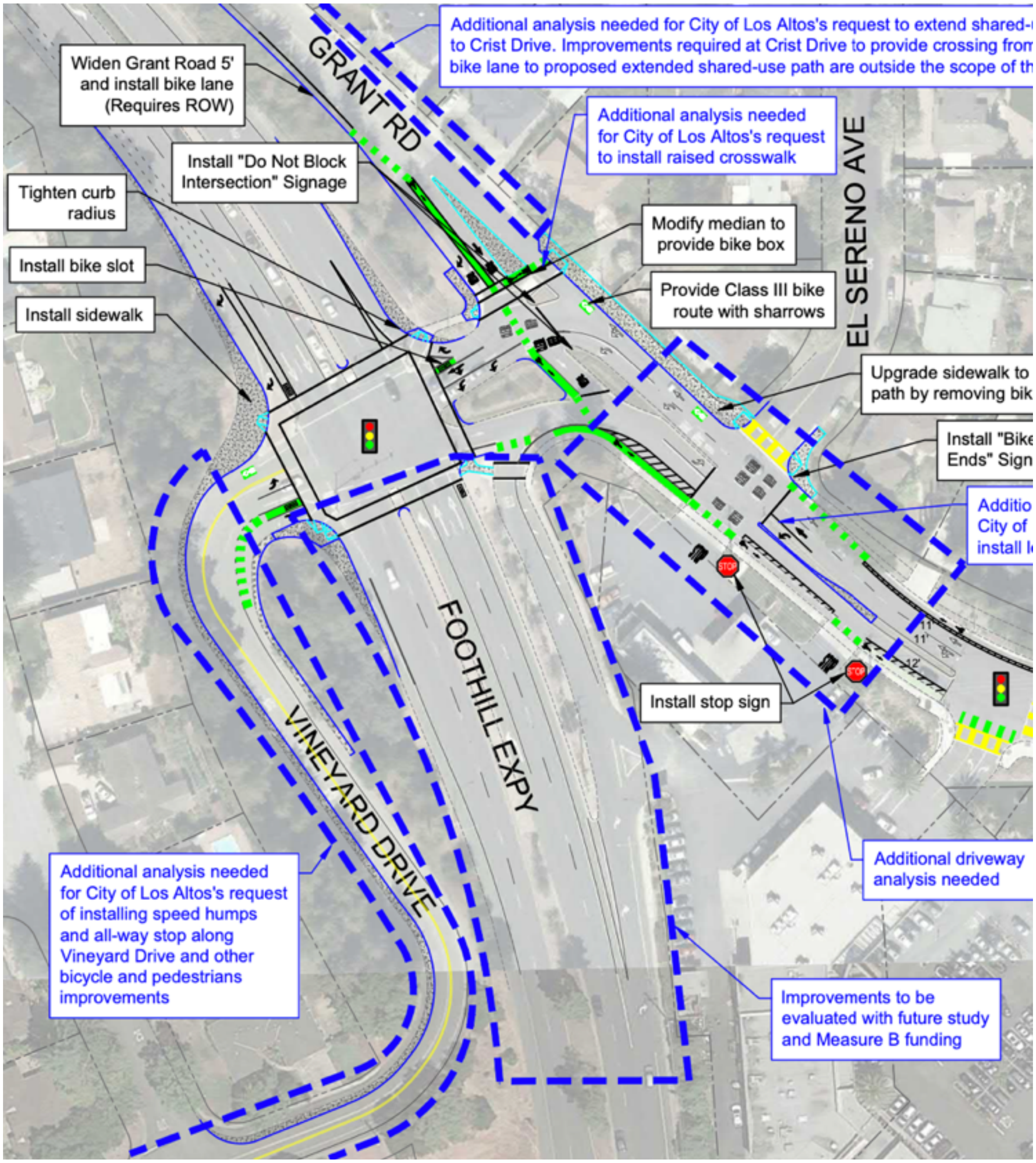


Figure 3.4: Proposed Improvement for Homestead Road (part 1 of 6)

Relevance to Study

Identifying sources of funding is a crucial step in ensuring the viability of a project proposal. A variety of agencies, grants and funds are available for municipal projects; much of SR2S project funding comes from the federal government. However, in the city's budget, One Bay Area Grants and Sustainable Communities Grants provided by the California Department of Transportation (Caltrans) are some other resources that are helpful to highlight (Caltrans, 2018).

As a part of this study, I hope to identify basic costs for the infrastructure improvements suggested. Using the Homestead Road Study as well as up-to-date transportation related documents and plans, I can create an inventory of the recommended installments and their anticipated costs. These will be estimates and are not final figures to include in official documents.

CHAPTER 4

PROPOSED ALTERNATIVES

The Complete Streets design philosophy identifies the roles of streets in our daily lives. One key aspect is that the street can be shared by all modes of transport if proper infrastructure is provided. The streets located near educational establishments such as Irvington High School should therefore serve more than just motor vehicles. Achieving this vision of a well-balanced and well-kept multi-modal street requires the support of many parties including City staff, state and regional officials and the School Board (Vallier Design Associates, 2016).

Ideas and recommendations for this plan are organized by the following four goals:

1. Improved safety and convenience for all roadway users and all modes
2. Better accessibility and circulation for all roadway users and all modes
3. Well-connected active transportation infrastructure
4. Cost-effective and efficient roadway treatments

Goal 1: Improved safety and convenience for all roadway users and all modes

Implementing neighborhood level traffic calming and paying more attention to roadway design outside of the vehicular right of way is important. Improving traffic signal and street design are just two of many ways to achieve this goal. Provisions for bicyclists, pedestrians, and transit users have often been an afterthought in the roadway design process. However, reprioritizing active transport right-of-way can improve safety and convenience for all users (Fehr & Peers, 2020).

Roadway crossings play a vital role in determining the safety of the users. Crossings, both signalized and unsignalized, present conflict between motor vehicles and pedestrians. Strategies that can help increase safety at these locations are identified in the subsequent paragraphs, along with context for each type of improvement (Federal Highway Administration).

Signalized intersections

A typical signalized intersection is one where the pedestrian presses a button to request the walk signal during which all vehicular approaches have a red light. These are often referred to as an exclusive pedestrian phase as opposed to a concurrent pedestrian phase, where pedestrians cross when the parallel traffic receives a green light (Caltrans, 2018).

While exclusive pedestrian phasing is considered safe, it often presents issues. Pedestrians must wait till the next cycle of signal timing which can often be lengthy, especially at a busy or wide intersection. This delay in pedestrian crossing can sometimes lead to maneuvers to cross the street illegally and unsafely while the walk sign has not been activated. Such behavior increases the probability of vehicle-pedestrian and vehicle-bicycle collisions. In addition, exclusive pedestrian phasing often makes motorists believe that they do not have to look out for pedestrians in crosswalks when they are turning left or right. Pedestrians expect no vehicles to turn during the walk phase and can sometime overlook the cars failing to yield. For these reasons, careful consideration must be given to placing exclusive signals only in locations where travelers are likely to obey them (Caltrans, 2018).

There are situations where exclusive pedestrian phasing works well and provides improved safety. Generally, this is where pedestrian volumes are high, and turning vehicle volumes are also high. The intersection of Blacow Road and Greenpark Drive in front of Irvington High School's main entrance is a location where exclusive phasing would work well. At other intersections, this type of phasing may not work so well due to lower volumes of students attempting to cross Blacow Road. Figure 4.1 on the next page shows existing intersection at Blacow Road and Greenpark Drive in Fremont, which has concurrent phasing.

Unsignalized Intersections

Until recently, it was believed that marking crosswalks at unsignalized intersections decreases pedestrian safety and therefore crosswalk markings should be used very sparingly. However, traffic research has concluded otherwise. In many situations, especially near schools, marking a crosswalk does improve safety. Many times, a crosswalk is not sufficient to improve safety; other countermeasures need to be implemented (California Bicycle Coalition, 2017).

The Federal Highway Administration (FHWA) has identified a list of nine countermeasures that are proven to improve pedestrian safety at unsignalized or unprotected intersections. Fremont has implemented some of these countermeasures in other parts of town, and the strategies listed below provide clear guidance for when these countermeasures are appropriate.

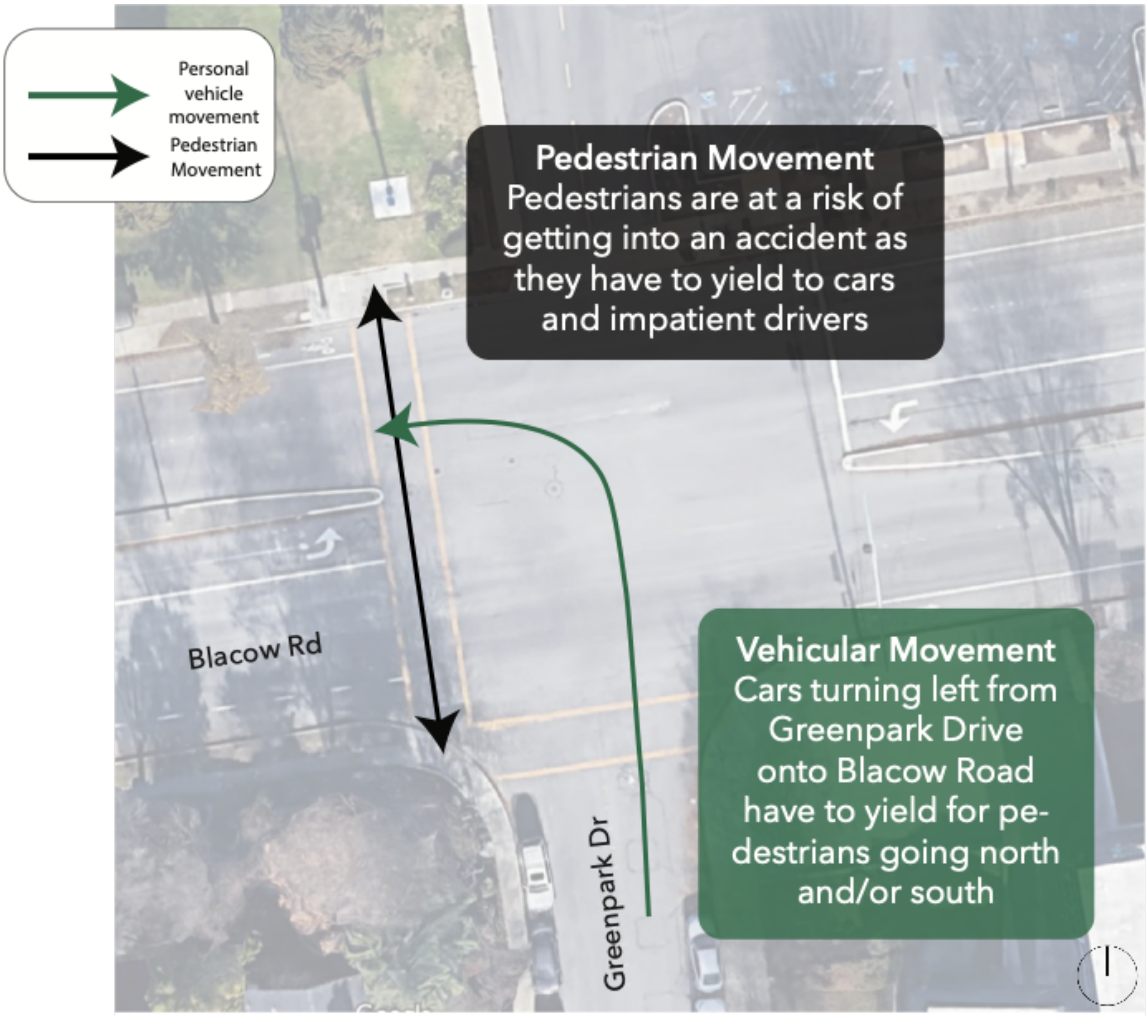


Figure 4.1: Existing Concurrent Phasing at Blacow Road and Greenpark Drive in Fremont

High Visibility Crosswalk (HVC)

This type of crosswalk is well-marked with the help of Continental markings, has parking set back 20 to 30 feet from the crosswalk, and has lighting 10 to 15 feet in advance of the crosswalk on all approaches. Removing parked cars improves driver visibility of the intersection and crosswalks creating a “daylighting” effect at the intersection. Figure 4.2 shows an example of HVC marking at Paseo Padre Parkway and Baylis Street in Fremont (Federal Highway Administration).

Figure 4.2: HVC at Paseo Padre Parkway and Baylis Street in Fremont

Raised Crosswalk

This serves as a traffic calming speed table and keeps the crosswalk at the same elevation as the sidewalk. Figure 4.3 is an example of a raised crosswalk (Federal Highway Administration).

Figure 4.3: Example of a Raised Crosswalk (Source: Federal Highway Administration)

Advance yield here to pedestrians sign and yield line

These signs are placed 30 to 50 feet in advance of the crosswalk and are accompanied by a “shark’s teeth” yield line. They lead the motorist to expect and watch for pedestrians. Figure 4.4 shows an example of “shark teeth” marking at Liberty Street and Sundale Drive in Fremont (Federal Highway Administration).

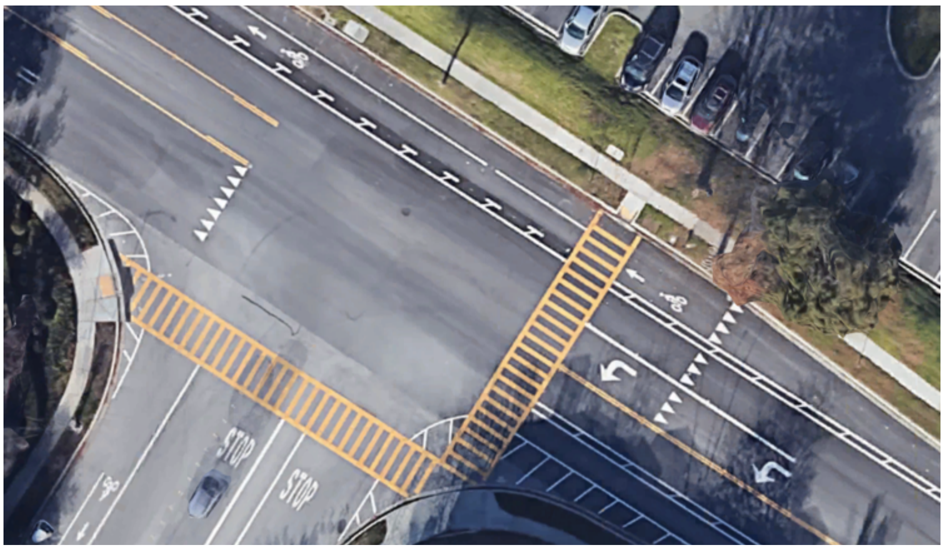


Figure 4.4: “Shark teeth” at Liberty Street and Sundale Drive in Fremont

In-street Pedestrian Crossing Sign

The in-street sign reminds motorists that they are to yield to pedestrians in crosswalks. Fremont has implemented such infrastructure in other parts of the city. Figure 4.5 is an example of an In-Street Pedestrian Crossing Sign in Chicago, Illinois (Federal Highway Administration).

Figure 4.5: In-Street Pedestrian Crossing Sign in Chicago, Illinois

Curb Extension

This is often known as a bulbout or bump-out and extends the sidewalks into the roadway or parking lane. It makes the pedestrian crossing distance shorter and makes the waiting pedestrians more visible to traffic. Figure 4.6 depicts a typical bulbout (City of Oakland, n.d.).

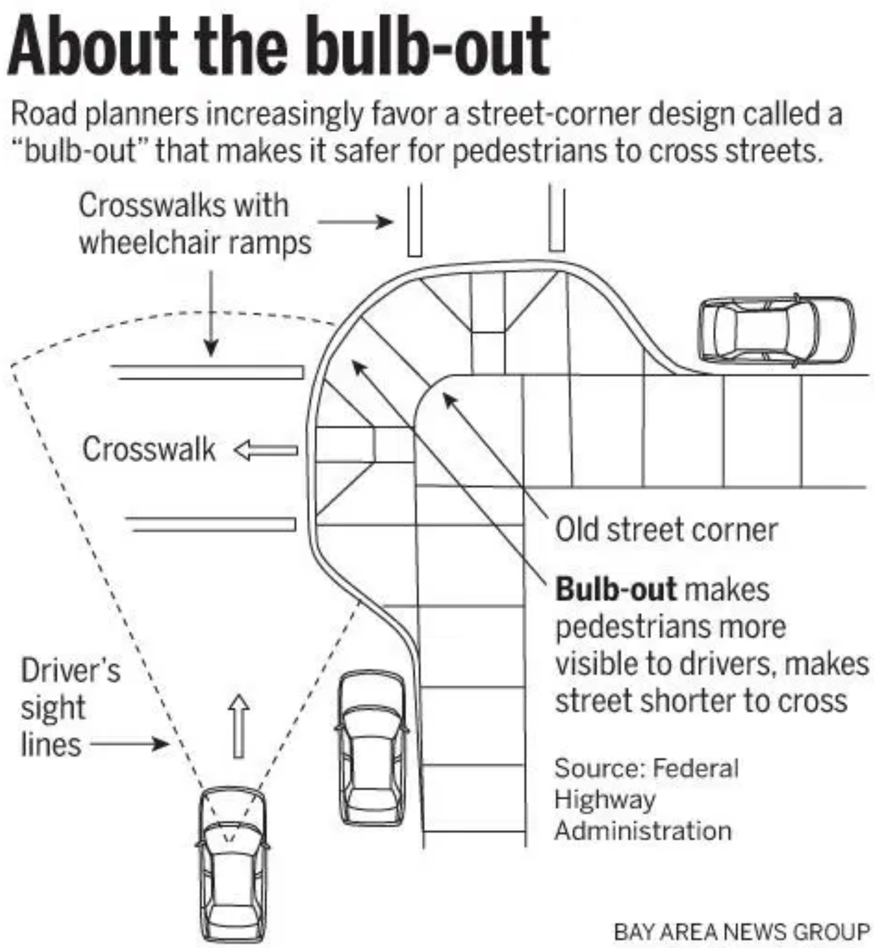


Figure 4.6: A Typical Bulbout (Source: The Mercury News)

Pedestrian Refuge Island

A refuge island provides a place for pedestrians to wait while crossing a roadway and enables the pedestrian to cross the street in 2 steps. Typically, it is used with 4 lane roads, such as Blacow Road. The median refuge must be at least 6 feet wide.

Maintenance of this type of a feature must be considered when evaluating implementation (Federal Highway Administration). Figure 4.7 shows a pedestrian refuge Island in New York City, New York.

Figure 4.7: Pedestrian Refuge Island in New York City, New York

Rapid Rectangular Flashing Beacon (RRFB)

This type of treatment is in use in Fremont. It includes large warning signs with beacons incorporated at the bottom of the sign. The beacon is activated when a pedestrian presses the actuation button, and the highly visible beacon becomes highly noticeable to the motorist (Federal Highway Administration). Figure 4.8 is an example of an RRFB in Lincoln, Nebraska.

Figure 4.8: RRFB in Lincoln, Nebraska

Road Diet

A road diet changes the roadway cross section, generally changing from a 4-lane cross section to a 3-lane cross section with a 2-way center turn lane or opposite left turn lanes. Figure 4.9 depicts a roadway before and after a road diet has been incorporated into the streetscape (Federal Highway Administration).

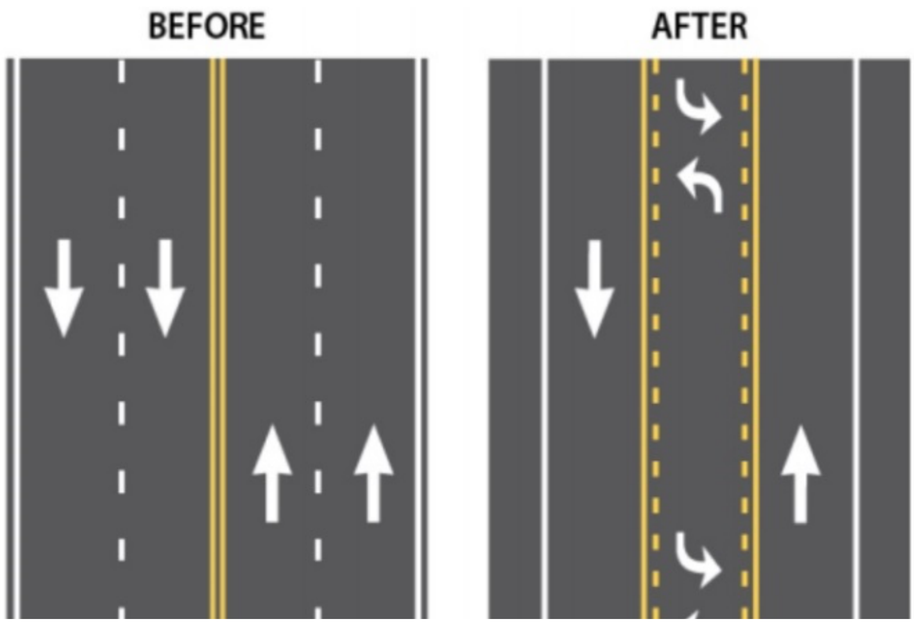


Figure 4.9: Road Diet (Source: Rice University)

Standard Street Markings

1. **Continental crosswalks:** research suggests that this type of crosswalk is more visible from a distance than crosswalks that only have transverse type markings. The reflective white stripes insure improved visibility.

2. **Pedestrian Scrambles:** it's a traffic light setup wherein pedestrians get an entire light cycle just for their own crossing purposes. If you're on foot, you simply get to the intersection, press the Walk button, and wait for the current green light cycle for cars to complete. Then all the traffic lights go to red, and the Walk signs in all directions light up. You can cross straight, left, right or even diagonally, without any concern for car traffic, as shown in Figure 4.10.

3. **Advance stop bars:** help motorists stop well before the crosswalk (and bike box, if applicable), improving visibility of pedestrians (Federal Highway Administration).

Figure 4.10: A Popular Pedestrian Scramble in Downtown Phoenix, Arizona

Speed Policies

Speeding creates several safety problems for pedestrians and bicyclists. As Figure 4.11 depicts, the faster a car travels, the more likely it is to result in a serious or fatal injury if a driver were to collide into a pedestrian or bicyclist. At 20 mph, there is a 5 percent chance that the crash will be fatal; at 30 mph, the likelihood of a fatality increases to 40 percent; and at 40 mph, there is an 80 percent chance that the pedestrian struck will be killed (PedSafe, n.d.). A second issue with high speeds is that as a driver's braking distance increases, a driver's ability to react to a pedestrian or bicyclist in the road decreases. Finally, as a vehicle travels fast, the operator's field of vision narrows, so that the driver is less likely to see a pedestrian or bicyclist along the edge of the road (Vallier Design Associates, 2016).

Figure 4.11: Vehicle Speed Comparison of Severity of Injury (Source: SFMTA)

Goal 2: Improved convenience and circulation for all roadway users and all modes

Designing proper circulation mechanics near schools can be challenging because of the interaction between vehicular, pedestrian, bicycle, and transit traffic. Intersections located closest to the main school entrance get backed up for a couple of hundred feet or sometimes a quarter to half mile; there is a high volume of people, cars and bikes trying to access the school facility (City of Ferndale, 2016). Such is the case at the intersection of Blacow Road and Greenpark Drive as well as where Sherwood Street meets the entrance to the parking lot of the Irvington Community Center. Under such circumstances, separating the routes for the multiple modes of transport can provide a more convenient and comfortable circulatory system and reduce traffic congestion and delays.

As there are currently a small number of permanent pedestrian, bicycle, and transit amenities located near the main entrance of Irvington High School, it is tedious to relocate such infrastructure. However, given a larger budget, major engineering and design changes can be made to improve circulation for all modes, which would be especially useful during pick-up and drop-off times. The proposed alternatives are detailed in the next few pages.

Alternative 1: Add street signage near the Irvington High School bus stop to indicate bus stopping times

Figure 4.12: Alternative 1: Street Signage

Alternative 2: Add a designated school bus loading zone in one of the two parking lots of Irvington High

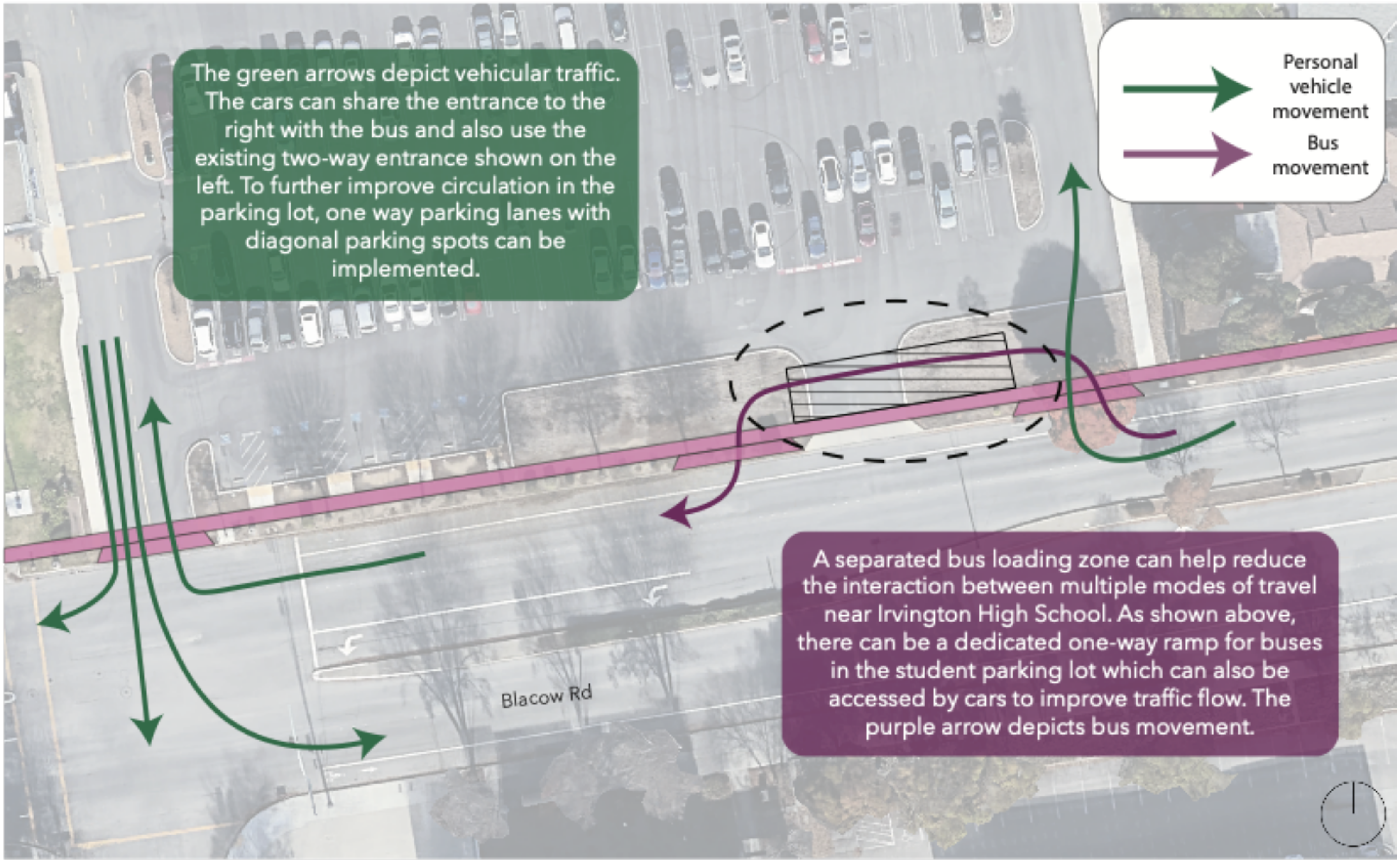


Figure 4.13. Alternative 2: Bus Loading Zone

Alternative 3: Dedicate a small portion of the Walgreens parking lot for drop-off and pick-up zones

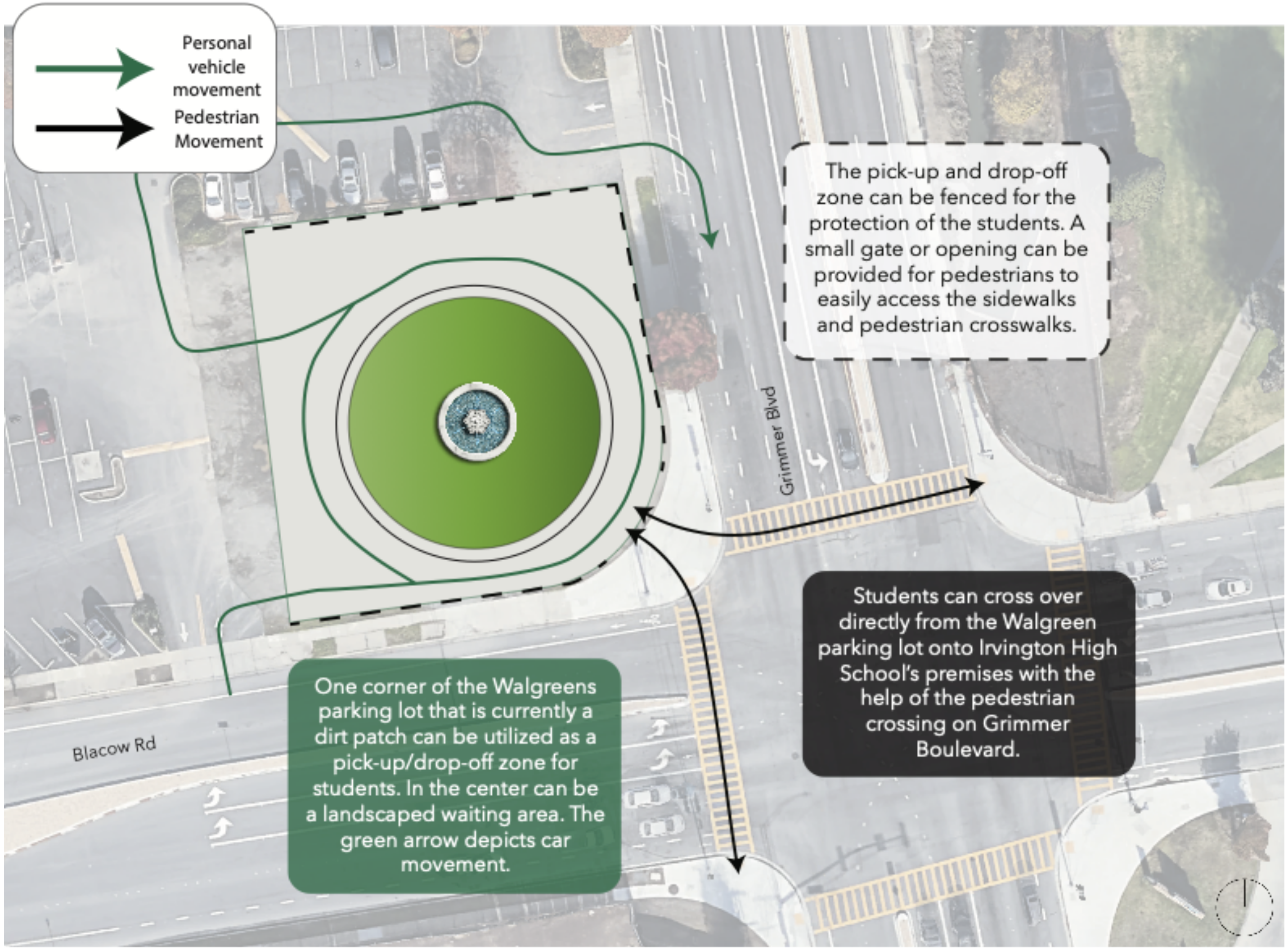


Figure 4.14: Alternative 3: Walgreens Pick-Up/Drop-Off Zone

Alternative 4: Design a bus pull-out in the green patch by the Administrative Parking.

A bus pull-out or turn-out is defined as "a dedicated stopping area for buses outside the travel lane" (Caltrans, 2018). Bus pull-outs help improve pedestrian safety and improve traffic flow as the bus is no longer blocking the travel lane. Incorporating a bus-pullout near Irvington High School will be useful for various reasons. Some of them include:

1. Providing a safer and more convenient place for students to wait for the bus
2. Improving traffic flow near the main entrance of Irvington High
3. Decreasing traffic congestion in the parking lots with the addition of another drop-off and pick-up zone

Although a large-scale infrastructure improvement such as this one may be more expensive, it can relieve traffic concerns near the school in the long run. An annotated bus pull-out map can be found in *Chapter 5 Recommendations*.

Goal 3: Well-connected and separated pedestrian and bicycle infrastructure

When individuals can choose to walk or bicycle or use transit and no longer need to own a car, it is estimated that they can save approximately $5000 to $10,000 per year. This is money that can be spent in the local economy, supporting local businesses. Additionally, it Is less costly for the city to build accommodations for pedestrians and bicyclists than to build new lanes of a roadway (California Bicycle Coalition, 2017).

The strategies within this goal are focused upon building out the pedestrian and bicycle networks, implementing traffic calming measures and connecting the pathway system. These strategies are to increase the number of persons with safe and accessible places for physical activity, provide greater access to economy for those who can't afford a car, and provide non-motorized access to everyday destinations where residents live, work, play and in the case of this plan, study.

Pedestrian Systems

As identified in the Problem Definition section of this plan, sidewalks near Irvington High School, especially on Blacow Road and nearby residential streets are uneven and therefore dangerous for those who walk on them. The following techniques can be utilized to promote a more walkable corridor:

1. Establishing flat, wide, and paved sidewalks near the school (Figure 4.15)

2. Incorporating green infrastructure into Blacow Road's streetscape to provide a buffer between the sidewalk and vehicular right-of-way (Figure 4.16)

3. Providing benches and other street furniture by sidewalk spaces to ensure a "rest-area" (Figure 4.17)

4. Separating pedestrians and motorized vehicles with the help of bollards or planters if space permits (Figure 4.18)

Figure 4.15: Sidewalk Improvements in Seattle, Washington

Figure 4.16: Green Space Between Sidewalk and Street in Portland, Oregon

Figure 4.17: Bench on Sidewalk in Albany, Oregon

Figure 4.18: Bollards Separating Sidewalk from Street in San Francisco, California

Bicycle Systems

Providing bicyclists, a comfortable and enjoyable ride is important to promote students and faculty to bike to and from school. For some, the hazards posed by accommodations that are not bicycle-friendly could cause crashes or near-misses. If included in a project, these considerations should be considered applicable Complete Streets elements (Caltrans, 2018). Some of these elements include:

1. Designing rumble strips with considerations for bicyclists (Figure 4.19)

2. Bicycle friendly drainage grates (Figure 4.20)

3. Debris removal from the shoulder or bicycle facilities (Figure 4.21)

4. Bike boxes (Figure 4.22)

Figure 4.19: Rumble strips to remind vehicles to stay on the road

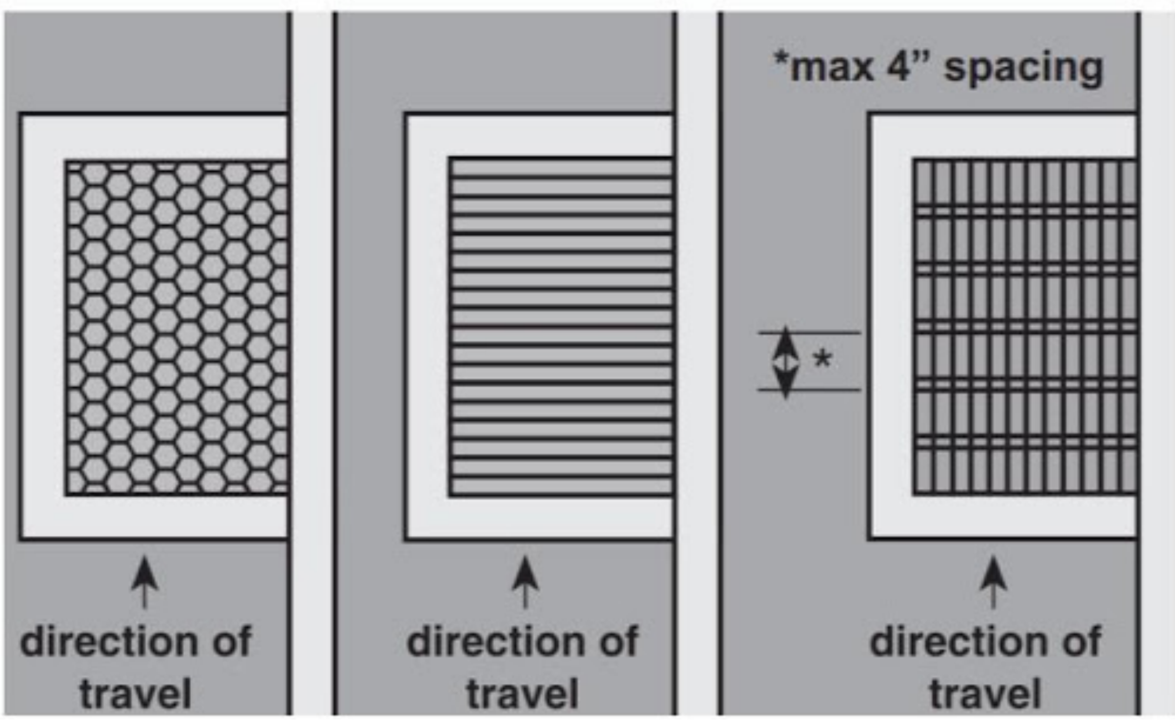


Figure 4.20: Bicycle friendly drainage grates (source: Federal Highway Administration)

Figure 4.21: Debris Blocking the Bicycle Lane in San Francisco, California

Figure 4.22: Bike Box in Long Beach, California

In addition, providing a more complete bicycle network can encourage biking in the community. Gaps in bicycle lanes or paths occur when bicyclists must switch from dedicated bike lanes to sharing the road or if parked cars block the bicycle lanes. Bicyclists often choose to ride on the sidewalk which infringes upon pedestrian right-of-way. Ensuring that curbside parking is not blocking bicycle lanes is important. Moreover, providing separated bikeways, when possible, can reduce conflict between vehicles and bicyclists (City of Fremont, 2016).

A bikeway that is separated from vehicular traffic using horizontal and vertical elements qualify as a separated bikeway. The use of flexible posts, inflexible physical barriers, planters, and curbs are common. Bicycle crossings at intersections can also be separated from pedestrian crosswalks to reduce the interaction between pedestrians and bicyclists. At protected intersections, improvements for pedestrians and bicyclists that maintain the bikeway at the intersection and provides separation from automobile traffic might be helpful (City of Ferndale, 2016).

Goal 4: Cost-effective and efficient roadway treatment

Funding can be a critical barrier to advancing Complete Streets projects. However, Fremont has several sources available to procure funding, and the City has been generating new funding that can be targeted to complete such projects.

City's General Fund

Under the City's General Fund, the maintenance of streets, parks and other roadway facilities has been assigned approximately $28,000 for the 2020-2021 Fiscal Year. Minor roadway improvements (such as paving sidewalks) can be funded by this source (California Bicycle Coalition, 2017).

Senate Bill (SB) 1

SB 1 is a new source of State funding to enhance highways, transit, and local roads statewide. Over a period of 10 years, Fremont is to receive $42 million in funding from SB 1, the Road Repair and Accountability Act. This new transportation program approved in 2017 aims to repair and maintain local roads, reduce congestion, and increase mobility options including bicycle and pedestrian facilities (City of Fremont, 2011).

Funding for SB 1 comes from gas tax and vehicle fees. Statewide SB 1 is expected to generate more than $5 billion annually for road repairs, to ease traffic congestion, to fill potholes, make seismic safety improvements to bridges and overpasses, and repair local streets and freeways. Funding in SB 1 is split equally between state and local governments for highway and local repair and maintenance. For cities, SB 1 can double the amount each receives from the state for local street maintenance and rehabilitation needs (City of Fremont, 2011).

Social Services Grant Program

The City of Fremont Human Services Department provides approximately $750,000 annually in Social Service Grant funds to public agencies serving low- and moderate-income Fremont residents. Eligible projects provide a safety net to persons facing a variety of life issues and assist persons who lack necessities (City of Fremont, 2011).

One Bay Area Grant (OBAG)

The Metropolitan Transportation Commission requires all jurisdictions to be eligible for OBAG funds, address complete streets principles through adoption of a complete streets policy resolution or through adoption of a general plan that complies with the California Complete Streets Act of 2008 (City of Fremont, 2011).

Measure B

The Alameda County Transportation Commission requires all jurisdictions to be eligible to receive Measure B pass-through and Vehicle Registration fund funding. These policies should include ideal complete streets policies developed by the National Complete Streets Coalition (City of Fremont, 2011).

Safe Routes to School (SR2S) Grant Fund

Fremont is currently pursuing SR2S Grant funds for long term improvement projects, consisting primarily of long-range planning projects and major infrastructure improvements (City of Fremont, 2011).

CHAPTER 5

RECOMMENDATIONS

Taking the proposed alternatives into consideration along with financial feasibility, I have identified the following recommendations for Blacow Road between Fremont Boulevard and Grimmer Boulevard. Although the intersection of Blacow Road and Grimmer Boulevard was included in the final analysis, no intersection improvements have been recommended as the City of Fremont has projects planned for this intersection (City of Fremont, 2011).

The recommendations have been broken down by the goal area identified in the previous section with Goal 1 and 3 combined. They are as follows:

1. Goals 1 and 3: Improved safety and convenience for all roadway users and all modes; and well-connected active transportation infrastructure
    a. Figure 5.1
    b. Figure 5.2
    c. Figure 5.3
    d. Figure 5.4
    e. Figure 5
2. Goal 2: Better accessibility and circulation for all roadway users and all modes
    a. Figure 5.6
    b. Figure 5.7
3. Goal 4: Cost-effective and efficient roadway treatments
    a. Table 5.1

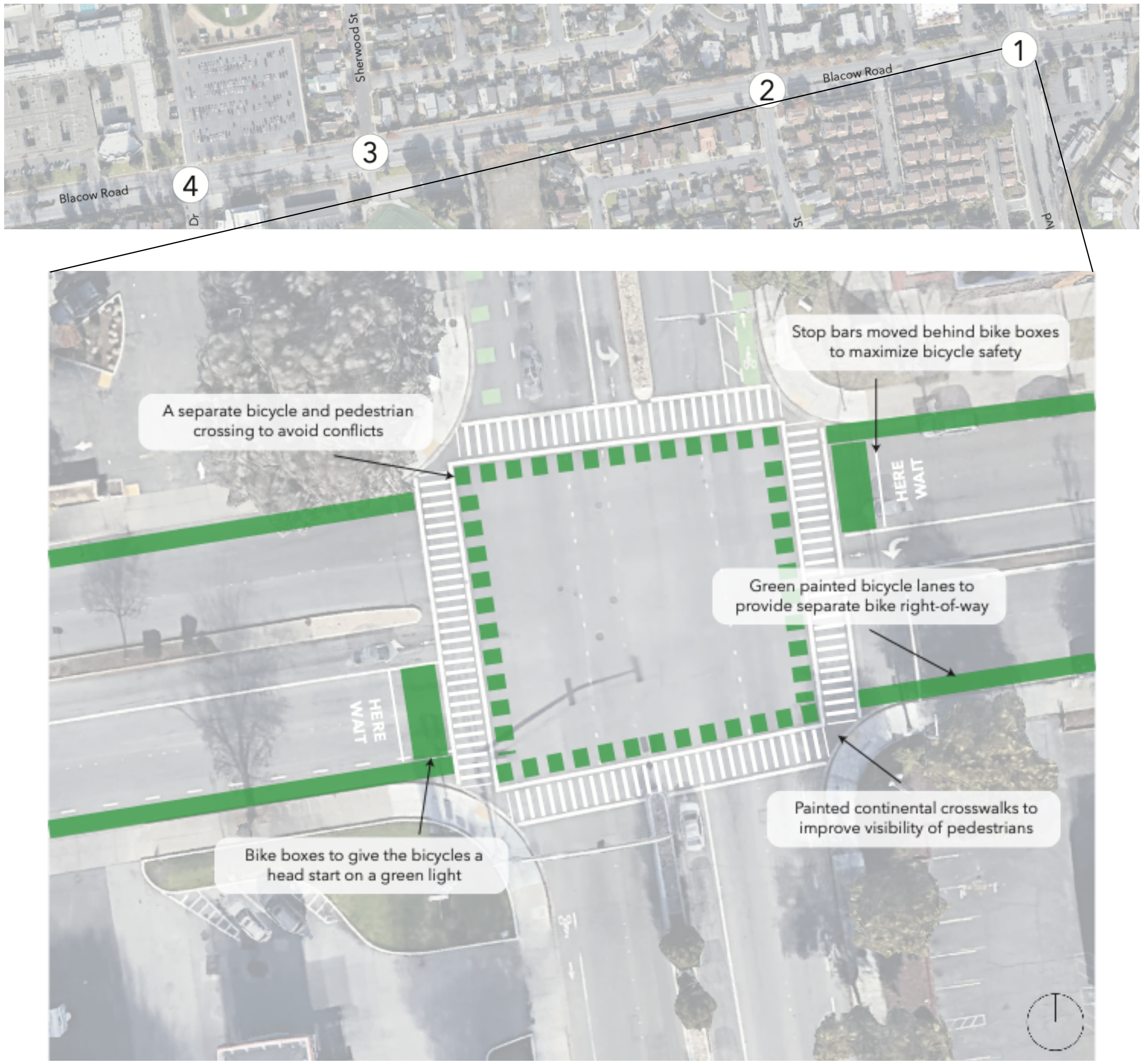


Figure 5.1: Recommended Improvements at the Intersection of Blacow Road and Fremont Boulevard

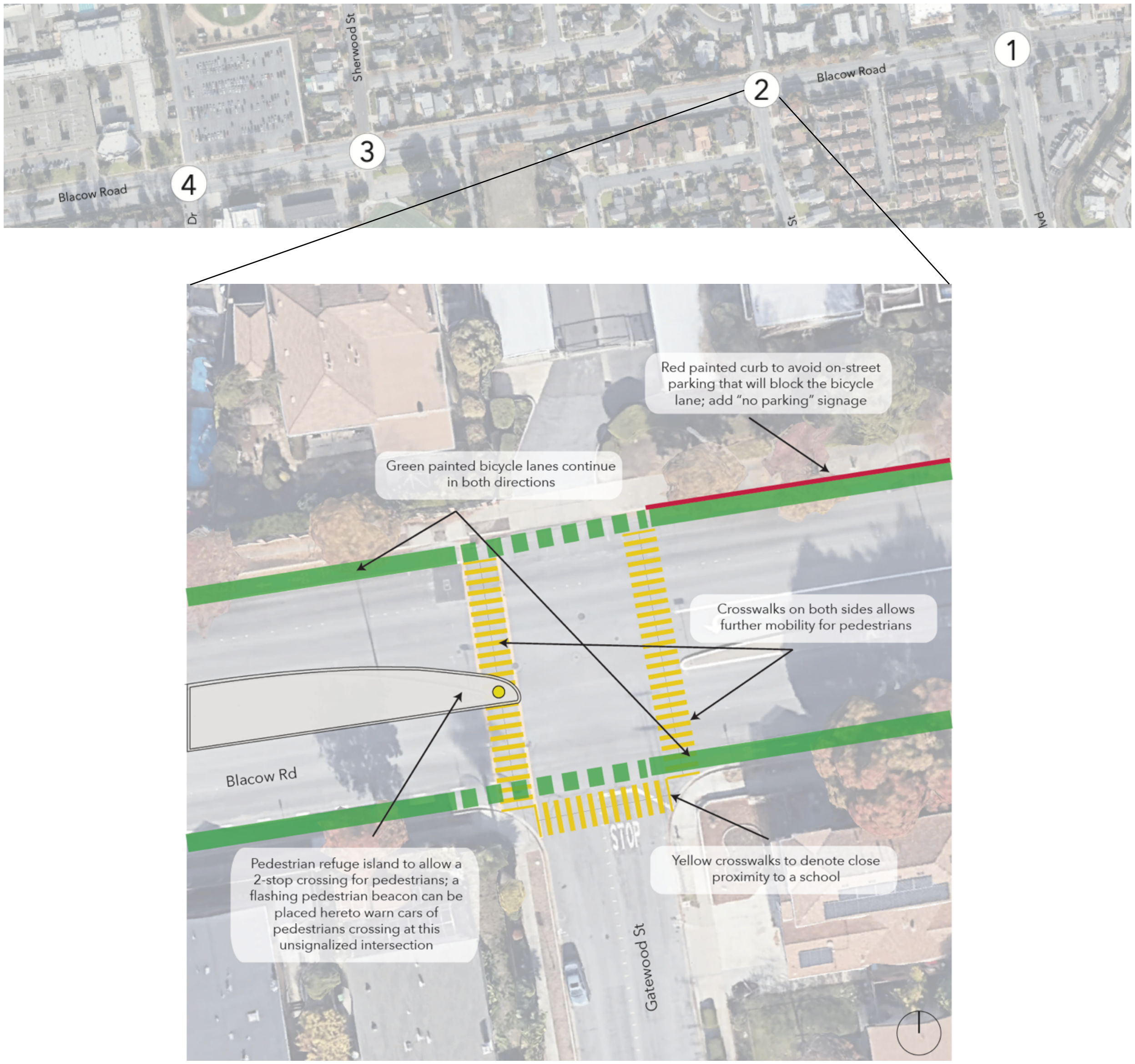


Figure 5.2: Recommended Improvements at the Intersection of Blacow Road and Gatewood Street

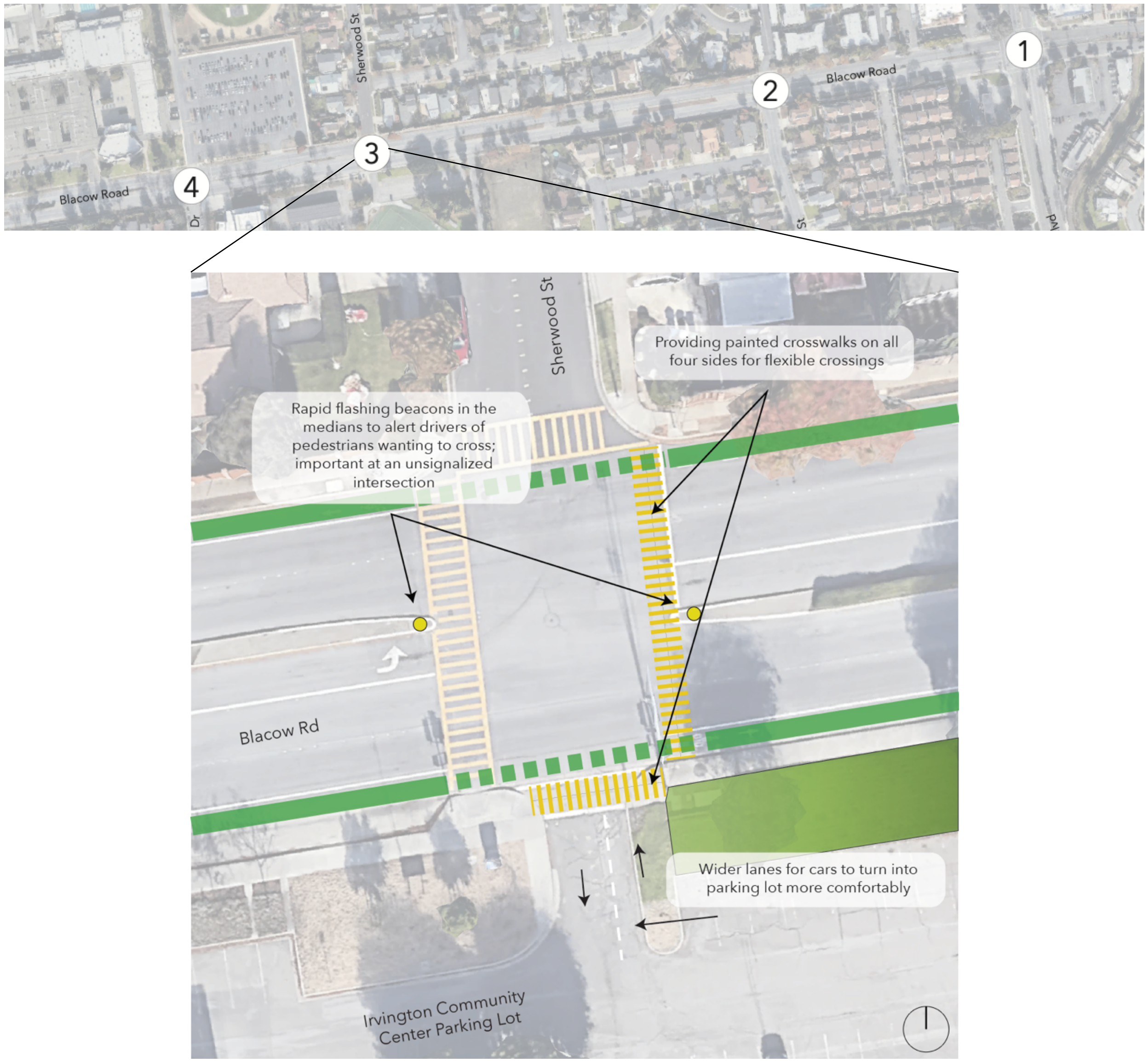


Figure 5.3: Recommended Improvements at the intersection of Blacow Road and Sherwood Street

Figure 5.4: Recommended Improvements at the Intersection of Blacow Road and Greenpark Drive

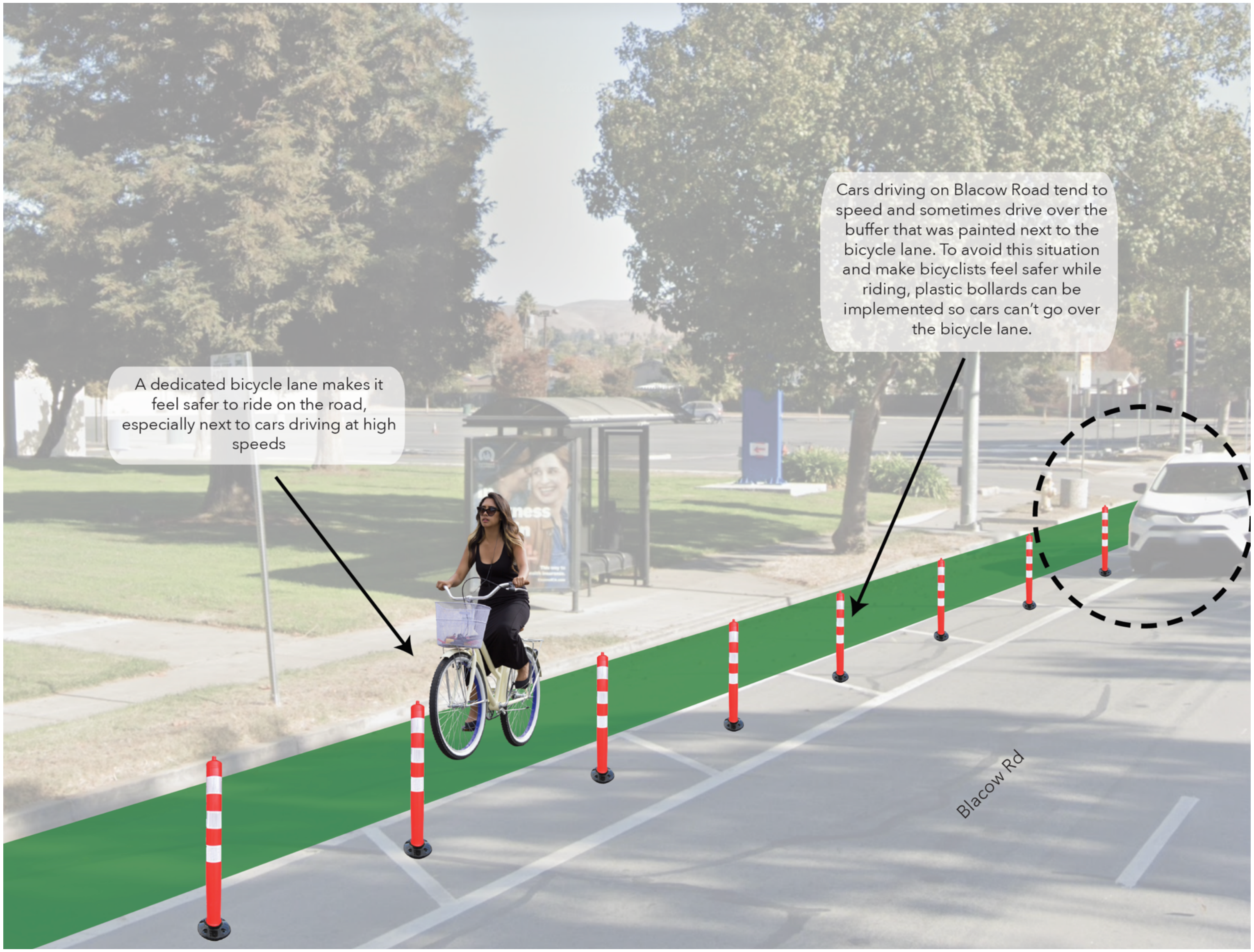


Figure 5.5: Recommended Improvements for Bicycle Lane on Blacow Road, Adjacent to the Bus Stop

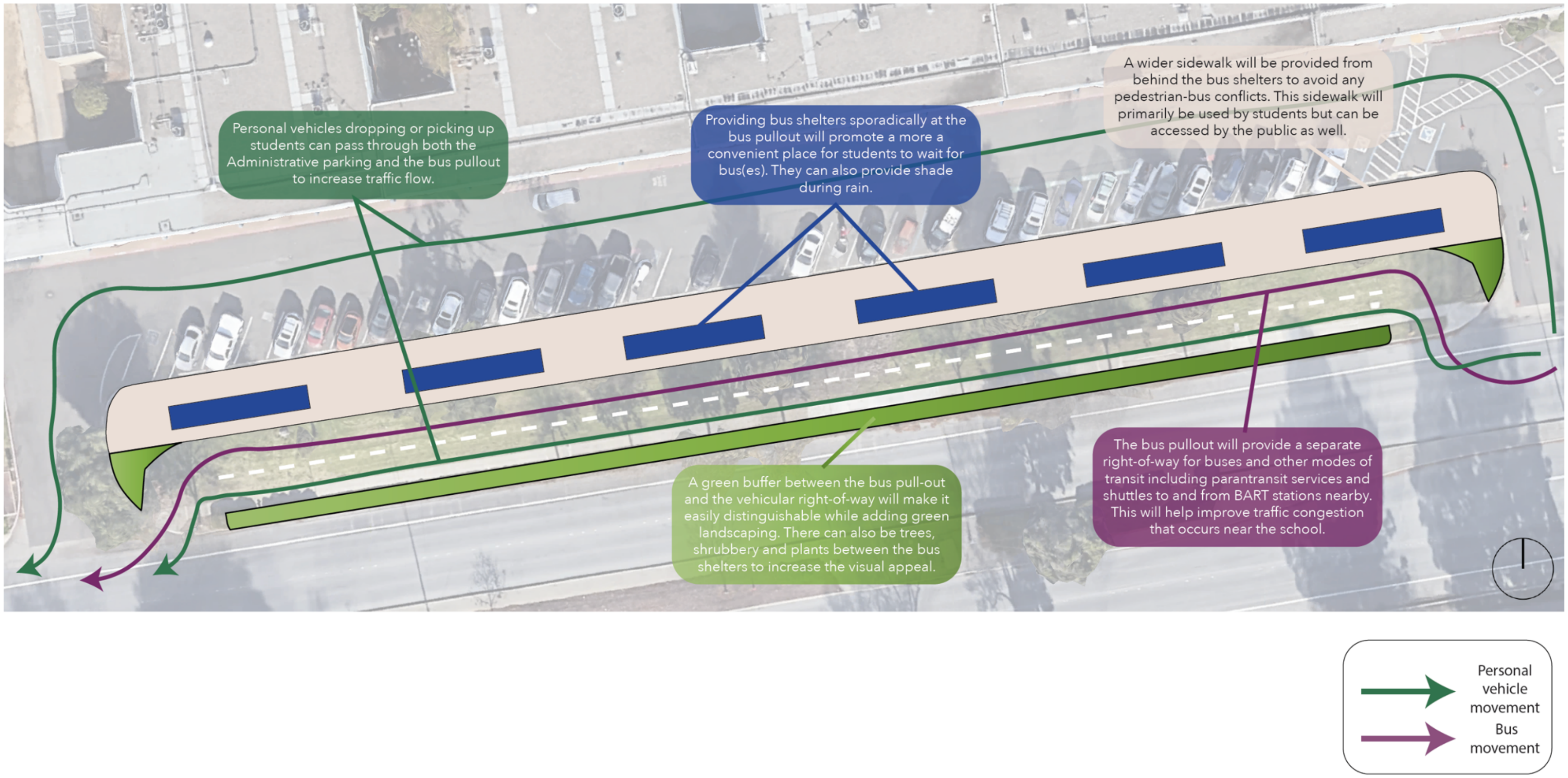
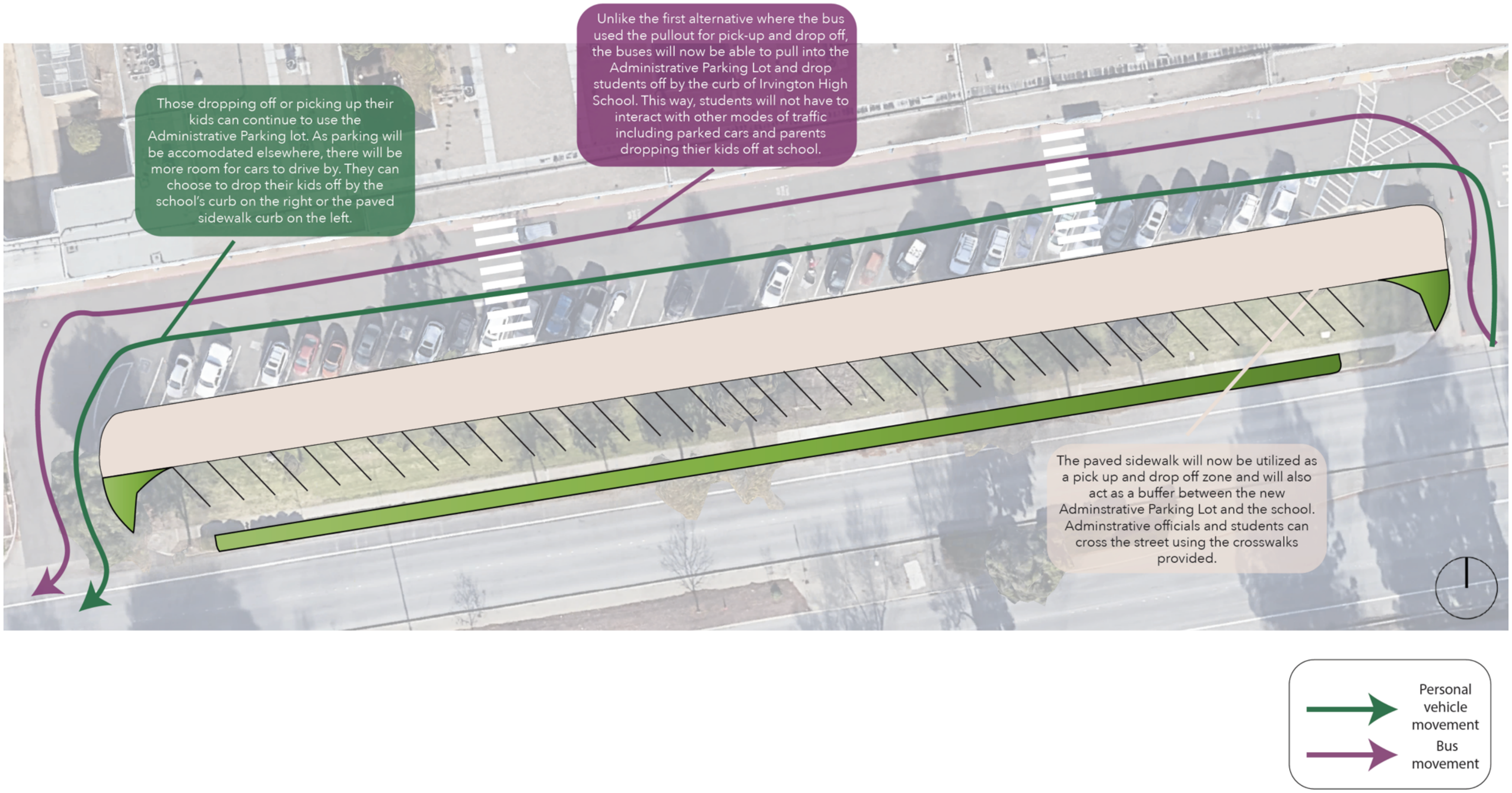


Figure 5.6: Alternative 4.1 from Goal 2; Bus Pullout by the Administrative Parking Lot



Alternative 4.2 from Goal 2; Relocating Administrative Parking Lot

The estimated costs to implement the recommendations are provided in Table 5.1. If utilities must be relocated or land acquired to implement any of these facilities, the costs will increase. However, many of these facilities may be implemented during development of adjacent land uses or in conjunction with other projects. Therefore, some of these costs will not be directly borne by the City (Fehr & Peers, 2020).

Project cost estimates for sidewalks and bicycle lanes are based on per mile cost of implementation; intersection improvements are per intersection; and the bus pullouts and loading zone estimate are for one infrastructure improvement. Installation costs for infrastructure like flashing beacons and signs is per unit. The estimates are based on a 2017 project conducted in the City of Fremont. More information on project priorities and cost estimate calculations can be found in Appendix B. Based on the prioritization criteria, a fair assumption can be made that the infrastructure improvements are of medium priority.

Table 5.1: Cost Estimate Summary

Description	Quantity	Unit	Cost/Unit	Total Cost
Flashing Beacons/RRFB	2	EA	$42,000	$84,000
Concrete Sidewalks Paving	0.5	MI	$6,000	$3,000
Class II Bike Lanes	0.5	MI	$72,663	$36,331
Class III Bike Routes	0.5	MI	$13,443	$6,722
Intersection Improvements	4	EA	$27,416	$109,664
Bus pullout/paving	1	EA	$340,000	$340,000
TOTAL				**$579,717**

References

Alta Planning & Design. (2016, December 13). *City of Fremont.* Retrieved from https://www.fremont.gov/DocumentCenter/View/34685/Fremont_PedPlan_Final-Adopted_Dec2016_Low-Res?bidId=

Alta Planning & Design. (n.d.). *Pedestrian Master Plan.* Retrieved from City of Fremont: https://fremont.gov/DocumentCenter/View/37739/Chpt-2-PED?bidId=

Alta Planning & Design. (n.d.). *Safe Routes to School Toolkit.* Retrieved from City of Fontana: https://www.fontana.org/DocumentCenter/View/27010/ATP-Safe-Routes-to-School

California AA Roads. (n.d.). *California 84.* Retrieved from California AA Roads: https://www.aaroads.com/california/ca-084.html

California Bicycle Coalition. (2017). *CALIFORNIA BICYCLE & PEDESTRIAN PLAN INVENTORY*. Retrieved from California Bicycle Coalition: https://www.calbike.org/resources/design_best_practices/bike_ped_plan_inventory/

Caltrans. (2018, July 23). *Complete Streets Elements Toolbox* . Retrieved from US Department of Transportation: https://dot.ca.gov/-/media/dot-media/programs/transportation-planning/documents/f0020348_complete-streets-elements-toolbox-a11y.pdf

City of Ferndale. (2016, June). *Transportation Element.* Retrieved from City of Ferndale : https://www.cityofferndale.org/wp-content/uploads/2017/12/Chapter-IV-Transportation.pdf

City of Fremont. (2011, December). *General Plan.* Retrieved from City of Fremont: https://www.fremont.gov/DocumentCenter/View/4666/03-Mobility?bidId=

City of Fremont. (2016, March). *Status Report and Action Plan.* Retrieved from Fremont Vision Zero 2020: https://fremont.gov/DocumentCenter/View/29505/Vision-Zero-2020-Final

City of Fremont. (2018). *General Plan Mobility Maps.* Retrieved from City of Fremont: https://www.fremont.gov/DocumentCenter/View/6228/Chap03-Mobility-maps?bidId=

City of Fremont. (n.d.). *History.* Retrieved from City of Fremont: https://fremont.gov/149/History

City of Oakland. (n.d.). *Longfellow Community Intersections*. Retrieved from City of Oakland: https://www.oaklandca.gov/projects/longfellow-community-intersections

City of Palo Alto. (2019). *Safe Route to School Program Data*. Retrieved from City of Palo Alto: https://www.cityofpaloalto.org/Departments/Transportation/Safe-Routes-to-School/Program-Data

Federal Highway Administration. (n.d.). *Road Diet Case Studies* . Retrieved from FHWA: https://safety.fhwa.dot.gov/road_diets/case_studies/roaddiet_cs.pdf

Fehr & Peers. (2018). *Bicycle Master Plan.* Retrieved from City of Fremont: https://fremont.gov/DocumentCenter/View/39940/1_Fremont-BMP_Ch1?bidId=

Fehr & Peers. (2020, August). *City of Manteca.* Retrieved from https://www.ci.manteca.ca.us/CommunityDevelopment/Planning%20Division/PlanningCommissionDocuments/2020%20Planning%20Commission%20Agendas/08-25-2020%20Planning%20Commission%20Agenda/Item%206.2%20%20Active%20Transportation%20Plan,%20Project%20No.%20MCA-19-0

Governing. (2014, December 9). *Vehicle Ownership in U.S. Cities Data and Map*. Retrieved from Governing: https://www.governing.com/archive/car-ownership-numbers-of-vehicles-by-city-map.html

Interstate Guide. (n.d.). *Interstate 680 California.* Retrieved from Interstate Guide: https://www.interstate-guide.com/i-680-ca/

Interstate Guide. (n.d.). *Interstate 880 California.* Retrieved from Interstate Guide: https://www.interstate-guide.com/i-880-ca/

Irvington Business. (n.d.). *A Brief History of Irvington.* Retrieved from Irvington Business: https://www.irvingtonbusiness.org/a-brief-history-of-irvington

Kimley Horn. (2019, May). *Homestead Road Safety Final Report.* Retrieved from Safe Routes to School: https://countyroads.sccgov.org/sites/g/files/exjcpb681/files/Homestead%20Road%20SR2S%20Final%20Report.pdf

Metro. (n.d.). *Complete Streets Training.* Retrieved from Metro: https://media.metro.net/projects_studies/sustainability/images/MetroCompleteStreetsTraining_ReferenceGuide.pdf

Mobility Solutions for Environmental Justice Communities. (2016, February). *Existing Conditions Report and Mobility Barriers Assessment.* Retrieved from Mobility Solutions for Environmental Justice Communities: https://www.sandag.org/uploads/projectid/projectid_546_22814.pdf

Neighborhood Scout. (n.d.). *Irvington District.* Retrieved from Neighborhood Scout: https://www.neighborhoodscout.com/ca/fremont/irvington-district

Nelson\Nygaard. (2016, December). *Vital Streets Plan.* Retrieved from City of Grand Rapids: http://nelsonnygaard.com/wp-content/uploads/2017/01/GRAND-RAPIDS-Vital-Streets-Plan.pdf

North Fair Oaks. (n.d.). *Circulation and Parking Analysis* . Retrieved from City of North Fair Oaks: https://planning.smcgov.org/sites/planning.smcgov.org/files/documents/files/NFO_FinalPlan_APPENDIX_C_Circulation&Parking.pdf

PedSafe. (n.d.). *Case Studies*. Retrieved from PedSafe: https://www.cityofconcord.org/DocumentCenter/View/1799/Downtown_Concord_Corridors_Plan

Placer County Transportation Planning Agency. (n.d.). *PCTPA* . Retrieved from 2035 Regional Transportation Planning: https://www.pctpa.net/library/rtp/2035/Chapter%206.8.pdf

Safe Routes to School. (2019). *Safe Routes to School: Case Studies*. Retrieved from Safe Routes to School : https://www.saferoutespartnership.org/resources/safe-routes-to-school/case-study

The Aspen Institute. (2017, September). *Upper Valley Mobility Report*. Retrieved from The Aspen Institute: https://www.aspeninstitute.org/wp-content/uploads/2017/09/Community-Forum-Mobility-Report_Final.pdf

Urban Systems. (2014, November). *Master Transportation Plan*. Retrieved from City of Langley: https://city.langley.bc.ca/sites/default/files/uploads/Engineering/DOCSLANG-%23129347-v2-Master_Transportation_Plan_2014.pdf

US Census Bureau. (n.d.). *Explore Census Data*. Retrieved from United States Census Bureau: https://data.census.gov/cedsci/

US Census Bureau. (n.d.). *Fremont City, California*. Retrieved from US Census Bureau: https://data.census.gov/cedsci/profile?q=Fremont%20city,%20California&g=1600000US0626000

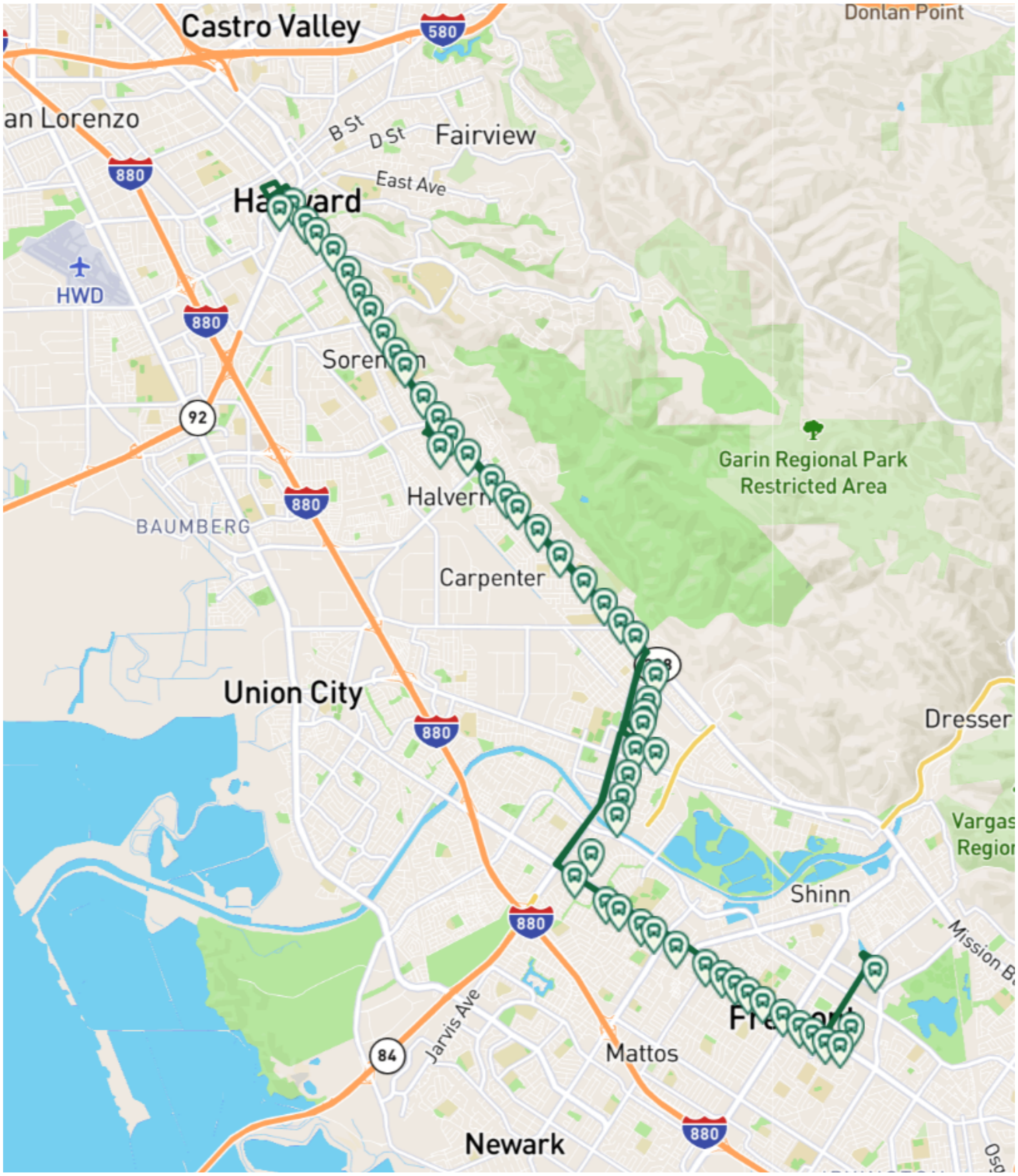
US Census Bureau. (n.d.). *Newark City, California*. Retrieved from US Census Bureau: https://data.census.gov/cedsci/profile?g=1600000US0650916

US Census Bureau. (n.d.). *Union City City, California*. Retrieved from US Census Bureau: https://data.census.gov/cedsci/profile?g=1600000US0681204

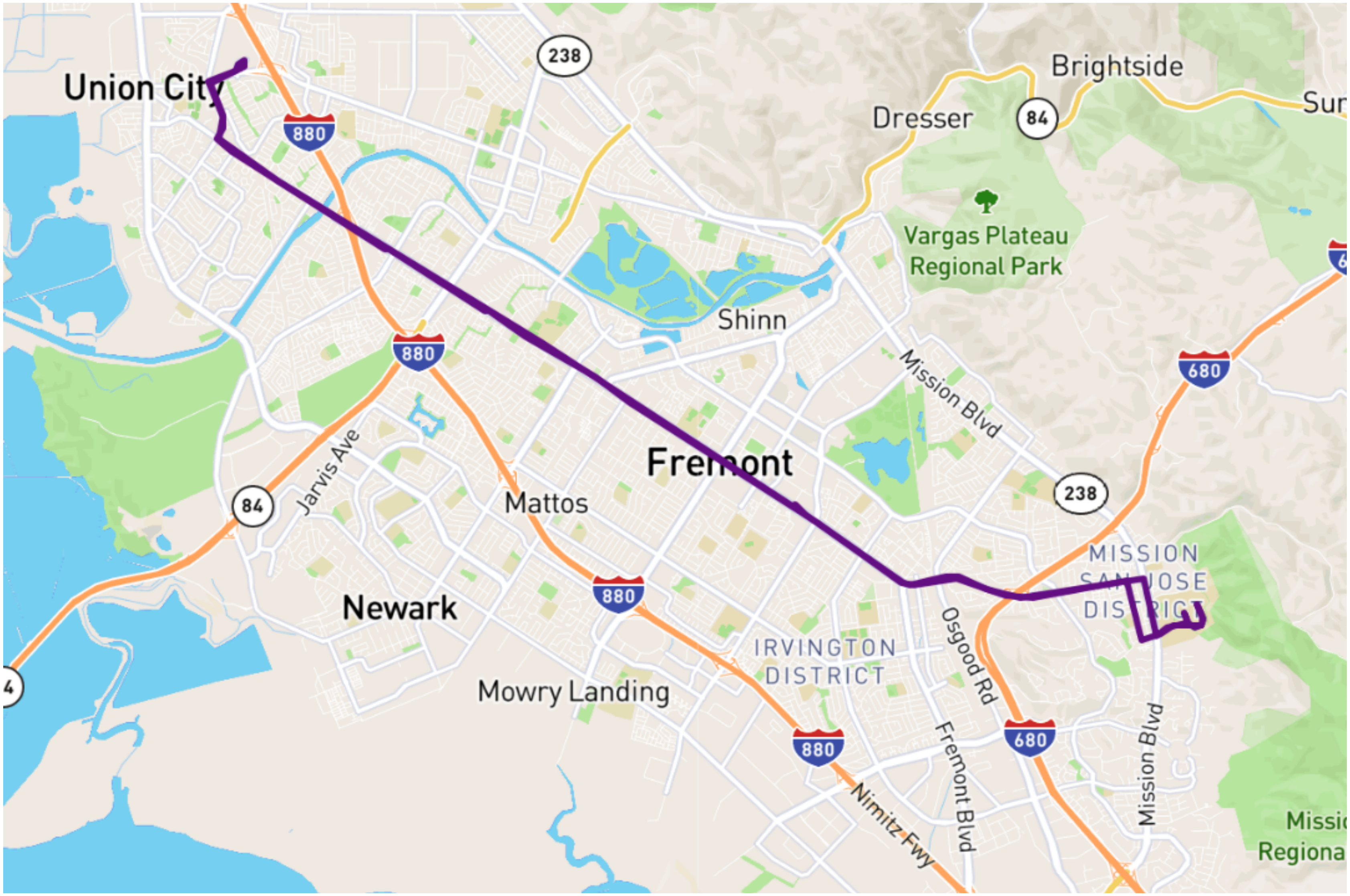
Vallier Design Associates. (2016, October). *Downtown Corridors Plan*. Retrieved from City of Concord: https://www.cityofconcord.org/DocumentCenter/View/1799/Downtown_Concord_Corridors_Plan

Appendix

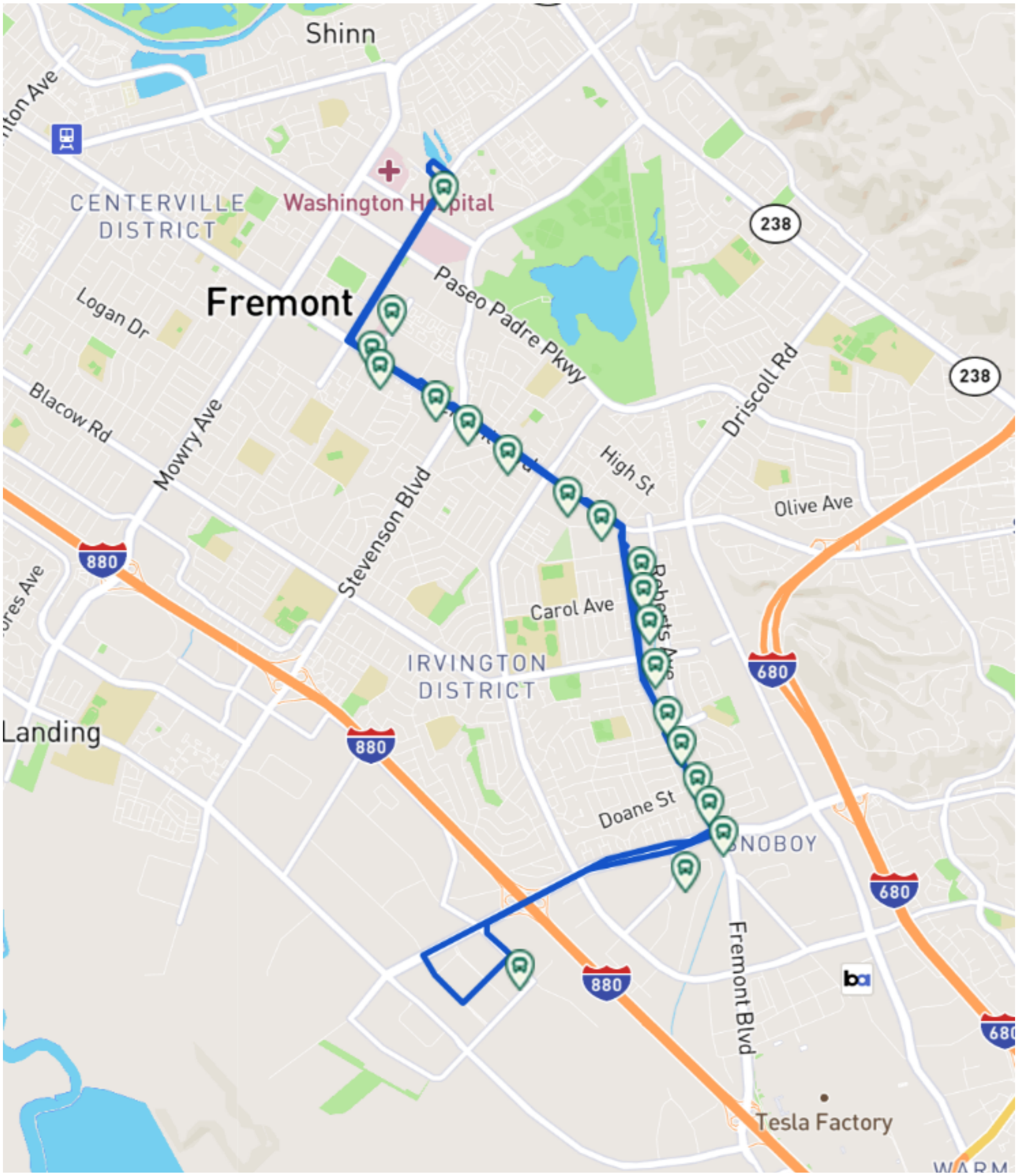
Appendix A: AC Transit Lines Serving the Irvington District in Fremont



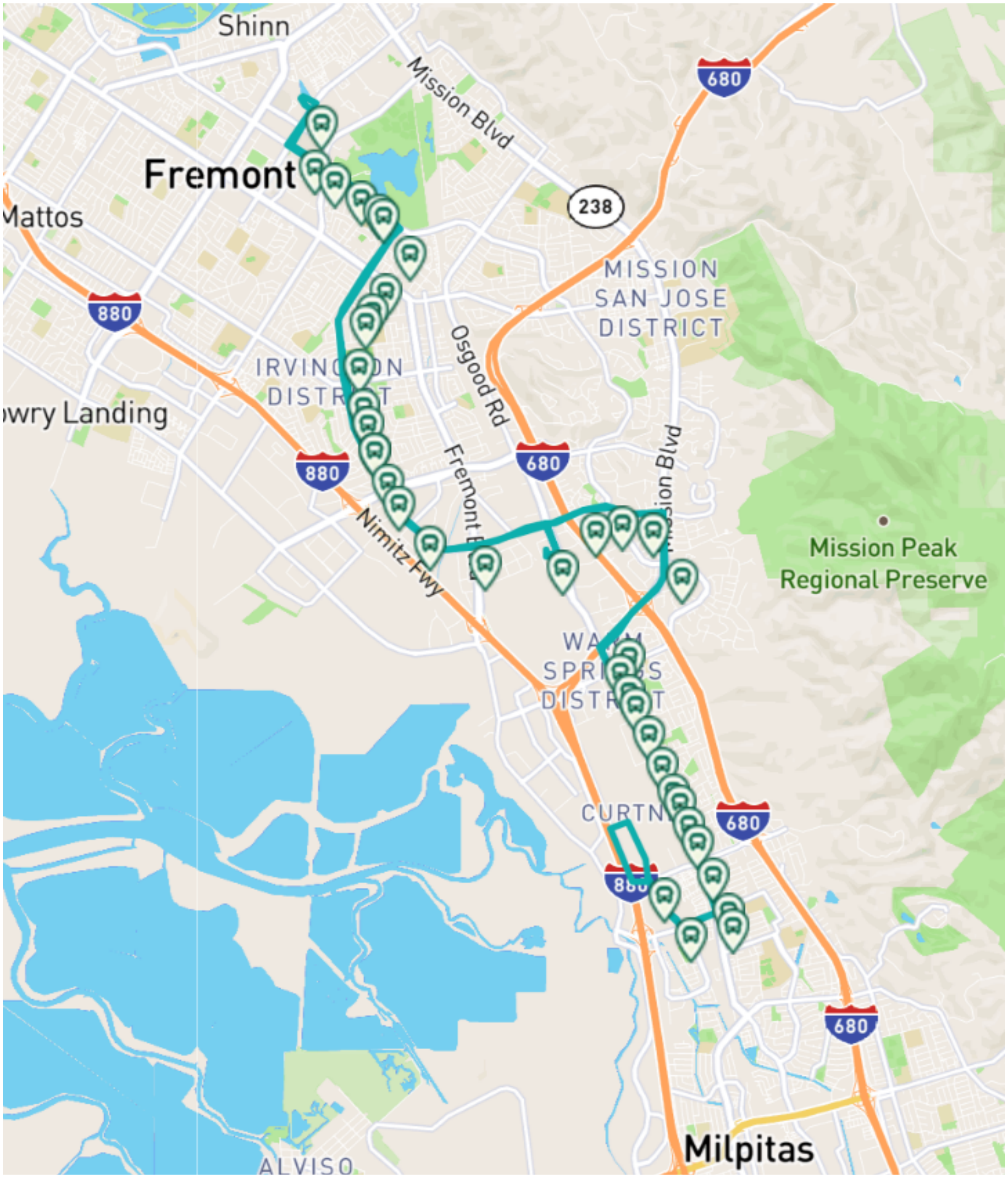
Line 99: Mission Blvd – Decoto Rd – Fremont Blvd



Line 210: Fremont Blvd – Mission San Jose



Line 212: Fremont Blvd – Pacific Commons



Line 239: Grimmer Blvd – Warm Springs Blvd

Appendix B: City of Fremont Active Transportation Plan Cost Estimates

Implementation of the planned bicycle and pedestrian networks is anticipated to occur:

1. Through active transportation projects pursued to implement this plan
2. In conjunction with adjacent land development projects
3. In conjunction with maintenance and capacity enhancement projects, such as slurry seals, pavement reconstruction, roadway widening, or sidewalk rehabilitation projects

Implementation will require many years to complete. Implementation of priority projects will be targeted for completion in the next five to ten years. Implementation of each project is dependent upon availability and acquisition of funding. Projects requiring land acquisition or utility relocation will require extra time to implement. Improvements associated with work on adjacent roadways or development of adjacent land uses will provide opportunities for implementation relatively easily or at lower cost than if implemented separately. In these cases, lower priority improvements may be implemented before higher-priority improvements, depending on the location of these land development and roadway projects. Implementation of each project is also dependent on detailed feasibility and design studies based on local conditions.

Completion of projects in this plan will be reported by staff to the City Council and on the City's website. The City of Fremont will periodically update this plan to reflect evolving needs and progress toward completion.

Prioritization

The projects identified to create these networks were prioritized as high, medium, or low based on several criteria:

1. proximity to key destinations, including schools, parks, medical facilities, and activity centers
2. collision locations
3. disadvantaged community indicators » population density

4. location along a high-priority corridor » public comment

5. judgement of local jurisdiction staff

Planned Bicycle and Pedestrian Facilities

Planned bicycle and pedestrian facilities are summarized in Table 5. These build-out pedestrian and bicycle networks are the long-term vision of the active transportation facilities for the region. The networks include shared-use paths, bike lanes and routes, separated bikeways, sidewalks, and crosswalk improvements. The proposed networks are designed to connect neighborhoods in each community to key destinations and to serve as recreational assets"

Table 5: Planned Bicycle and Pedestrian Facilities

Type	Total Miles
Sidewalks[1]	29.2
Class I Bike Paths (Multi-Use)	9.2
Class II Bike Lanes	60.4
Class II Buffered Bike Lanes	11.0
Class III Bike Routes	7.9
Class IV Separated Bikeways	1.5

Table 6: Cost Estimate Summary

Type	Priority			Total
	High	Medium	Low	
Sidewalks	$12,163,300	$12,617,700	$10,274,700	$35,055,700
Class I Bike Paths (Multi-Use)	$314,200	$2,018,200	$1,698,500	$4,030,900
Class II Bike Lanes	$3,538,600	$4,388,900	$5,104,800	$13,032,300
Class III Bike Routes	$1,269,100	$106,200	$2,239,100	$3,614,400
Class II Buffered Bike Lanes	$223,200	$1,139,400	$240,800	$1,603,400
Class IV Separated Bikeways	$380,700		$170,900	$551,600
Intersection Improvements	$1,219,300	$1,370,800	$742,000	$3,332,100
Total	$6,945,100	$9,023,500	$10,196,100	$26,164,700

Source: Fehr & Peers, 2020