MEMORANDUM

June 23, 2023

To: Christopher Kidd and ACP Technical Advisory Committee
Organization: San Francisco Municipal Transportation Agency
From: Mia Candy, Joanna Wang, Peter Garcia, Adam Wood, Nan Jiang
Project: San Francisco Active Communities Plan

Re: Task 2A Draft Network and Count Analysis

Introduction

This memorandum presents findings from the Active Communities Plan (ACP) network and count analysis. Key findings are called out on pages 1 - 3, followed by more in-depth analysis and explanation of methods. Findings from this analysis will be used to inform next steps, including follow-up analysis, focused community engagement, and development of recommendations.

Purpose of the Network and Count Analysis

The purpose of this analysis is to understand the intensity of bike and micromobility use across San Francisco. By understanding where people ride today, and how ridership is related to the existing active transportation network, the project team can start to identify gaps in the network and opportunities for improvements. This analysis addresses the following key questions:

- Where are people riding bicycles and other micromobility devices? Where are people *not* riding? Why might ridership be distributed in the ways that it is?
- Where is ridership in relationship to the network? Are people using the network? Why or why not?
- Where is the network over- or under-performing? Where do we see low ridership on high-quality facilities, or vice versa?
- How is the network distributed across neighborhoods?
- What kind of ridership and network coverage is there in each of the six Equity Priority Communities (EPCs)?
- What can ridership and network coverage tell us about critical network gaps?

Key Findings

This analysis produced the following key findings:

- Network Coverage and Quality:
  - Twenty-four percent of centerline miles in San Francisco have bike facilities.
  - Eight percent of San Francisco's centerline miles have high-quality facilities, which are defined as separated bikeways, bike paths, slow streets, and car-free streets.
  - Of the six EPCs, SoMa has the best network coverage (36%) and quality (22%). On the other hand, Western Addition/ Filmore has zero high quality facilities.
- Bike Commute Rates:
  - In 2021, 3.1% of San Francisco residents biked or used another micromobility device to commute to work – down from 3.8% in 2018.
  - Bike commuting is concentrated in dense, flat, urban neighborhoods, areas with high job density, and in places with close access to bike facilities. For example, in Hayes Valley, over 8% of residents commute by bike.
  - In dense urban neighborhoods, bike commuting is associated with households that do not own cars.

    - In lower-density, primarily residential neighborhoods further from employment centers, there is no correlation between zero-car households and high rates of bike commuting.
- Micromobility Volumes:
    - Data from Bay Wheels (Lyft) and Scooter-Share vendors show that:
        - Micromobility activity is concentrated in dense urban areas, and on streets with bike facilities.
        - In busy commercial areas, micromobility riders tend to ride on higher-comfort routes (i.e., high Bicycle Comfort Index [BCI] scores) rather than parallel, lower-comfort routes. For example, micromobility activity is concentrated on Polk Street, rather than Van Ness Avenue.
        - Micromobility ridership is low in the south and west of the city, largely due to the low number of bikeshare stations in these areas. Bay Wheels policies do incentivize electric bikeshare (which do not need to be parked at a bikeshare station) in those service areas by capping rates and waiving fees, but it has not resulted in corresponding increases in ridership.
        - The Great Highway/Great Walkway is a major destination for people renting e-bikes and e-scooters.
- Bicycle Activity:
    - Data from the SFMTA's automated bicycle counters show that:
        - On average, volumes fell by about a third citywide between 2018 and 2022. But not all neighborhoods experienced this trend. Counters in the Inner Richmond, Inner Sunset, Potrero Hill, and Russian Hill captured an increase in volumes over the last five years.
        - On streets that received quick-build interventions in 2022, bicycle trips increased a total of 27%.
        - The Slow Streets with the highest bike volumes are Shotwell Street, Clay Street, Lake Street, and Page Street. These streets are either in dense, urban neighborhoods or provide key connections across the city. The Slow Streets with the lowest volumes are concentrated in the southeast of the city in neighborhoods with low bike volumes overall, mirroring these neighborhoods' lower rates of bicycle mode share overall.
- Network Performance:
    - Volumes vs Facility Type
        - Most trips in San Francisco take place off-network because most streets in the city do not have bike facilities. But when volume is normalized by centerline mileage, the data show that there is an association between ridership and quality facilities. Facilities with protection from cars (i.e., separated bikeways) have the highest ridership per centerline mile than any other facility type. *Ridership per centerline mile increases as protection from cars increases.*
    - Volumes vs Network Quality
        - Low ridership on high-quality facilities can be an indicator that network improvements are needed, especially in high-density neighborhoods. A number of Class IV separated bikeways in San Francisco are under-performing, likely due to the vertical barrier type not being appropriate for the adjacent vehicular speeds, volumes, and curbside turnover. Lack of connectivity to the larger bike network or challenges intersections are other potential factors. Examples include Turk Street and Golden Gate Avenue in the Tenderloin, and Alemany Boulevard and San Jose Avenue in St Mary's Park/Glen Park/Mission Terrace. During network development, the project team will examine the precise reason for under-performance to identify appropriate treatments, and what other factors may contribute to these outcomes.
        - High ridership on low-quality facilities can be an indicator of demand, and an opportunity for improving conditions for many riders, especially in low-density neighborhoods. Ocean Avenue in southwest San Francisco is a good example of a street with high volumes, despite having a Class III Bike Route and a relatively low comfort score. During public engagement, the project team will consider options to meet this latent demand for east-west travel with appropriately low-stress facilities on or near the corridor.
    - Off-Network Volumes

        - Off-network streets are a critical part of how San Franciscan's get around. Off-network volumes can provide insight into key opportunities or network gaps. Where volumes are high, but bicycle comfort is low, it may indicate that there is a need for infrastructure enhancements or suitable parallel routes. Examples include Balboa Street and Clement Street in the Richmond and most of the off-network streets in the Tenderloin.
    - Volumes vs Network Coverage
        - When volumes are low, but network coverage is relatively high, it is an indication that the network may be under-performing due to other factors such as land use, density, connectivity, or network quality. Neighborhoods where the volumes are low relative to network coverage include Mission Terrace/Cayuga/Outer Mission, and the east-west corridors in the Sunset District. Further analysis is required to assess the precise reason for poor network performance, and identify appropriate policy, program, or infrastructure recommendations.

Next Steps

The project team will use the findings in this analysis to inform the following next steps:

- Conduct community engagement to ground-truth findings, and to collect feedback about why people may choose to ride in certain locations, and to avoid others.
- During community engagement, identify key destinations and barriers to identify gaps in and opportunities for improvement on the network.
- During community engagement, explore other barriers communities may experience that impacts use of the bike network.
- In places where the network is under-performing, conduct segment-level analysis to identify the precise reason for under-performance, and make appropriate network, policy, or program recommendations.
- In places where the network is over-performing, identify what precisely is working, and how that can inform network development and improvement in other parts of the city.
- Conduct an access or connectivity analysis to further identify geographic gaps in the network. Use the volume, safety, and Bicycle Comfort Index data to identify specific segments for improvement or priority.

Network Quality and Coverage

The project team analyzed network coverage across San Francisco's neighborhoods. Network coverage is defined here as the percent of centerline miles that have bike facilities. Table 1 shows that citywide, 24% of San Francisco centerline miles have any kind of bike facilities. Table 1 also shows that 8% of San Francisco centerline miles have "high quality" facilities which include:

- Class IV Bikeways (Separated Bikeways),
- Class I Bikeways (Bike Paths),
- Class III Bikeways (including only Class III facilities within the Slow Streets network), and
- Car-Free Streets (such as Car-Free JFK in Golden Gate Park and the Great Highway/Walkway)

The project team compared network coverage and quality in six Equity Priority Communities (EPCs) to citywide averages. Western Addition/Filmore and Excelsior have low network coverage, compared to the entire city as well as the other EPCs. SoMa, Mission, and Tenderloin are all located in San Francisco's dense urban center and as result, have some of the highest network coverage in the city.

When we evaluate *high quality* network coverage, SoMa has the highest share (22%) of centerline miles with high-quality facilities. This far exceeds the citywide average of 8%. Bayview-Hunters Point and Outer Mission/Excelsior have lower than average quality network coverage. Western Addition/Filmore has *zero* high quality facilities – there are no separated bikeways, bike paths, slow streets, or car-free streets within the formal neighborhood boundaries.

Table 1: Network Coverage and Network Quality Citywide vs. Equity Priority Communities

	Network Coverage	Network Quality	
Neighborhood*	**Percent of Centerline Miles with Bike Facilities**	**Percent of Centerline Miles with High Quality Facilities**	**Percent of Network that is High Quality**
Citywide Average	24%	8%	28%
Bayview-Hunters Point	23%	5%	21%
Outer Mission/	32%	7%	21%
Excelsior	9%	2%	16%
Mission District	30%	8%	28%
SoMa	36%	22%	61%
Tenderloin	28%	10%	38%
Western Addition/ Filmore	19%	0%	0%

*A table with the network coverage and network quality for all San Francisco neighborhoods is provided in Appendix A.

Bicycle Commuting

San Francisco's Climate Action Plan identifies a goal of 80% low-carbon trips by 2030. Converting commute trips from driving to active or shared modes will be a critical step in achieving the city's climate goals. To that end, the SFMTA is tracking bicycling commuting, and how it has changed year over year. The Active Communities Plan project team analyzed mode share data from the 2021 American Census Survey (ACS) 5-Year Estimates. Figure 1 and Figure 2 show bike commute mode share for San Francisco Census tracts in 2021 and 2018 (i.e., what percent of people living in each census tract commuted to work by bike). In 2021, bicycling made up 3.3% of citywide commute travel. This is down from 3.8% in 2018.[1] This decrease could be explained by COVID-related impacts, including the nationwide shift to remote work.

Where in San Francisco is bike commuting high, and why might that be the case?

The data show that bike commuting is concentrated in San Francisco's dense urban center in the neighborhoods surrounding Downtown and the Financial District. In Hayes Valley, the Mission District, Potrero Hill, and Haight Ashbury, over 6.8% of the workforce commutes to work by bike. Hayes Valley has particularly high rates of bike commuting – over 10%. Hayes Valley is also one of the few neighborhoods that did not see a decline in bike commuting between 2018 and 2021. Bike commuting is likely concentrated in these neighborhoods due to the density of (and proximity between) people, housing, and jobs. Compared to other parts of the city, bike routes in these neighborhoods are also relatively flat.

The data shows an association between bike commuting and bike infrastructure. There is a noticeable concentration of commuting around the "Wiggle" bike route which runs from Market Street to Fell Street. Bike commuting is also associated with a concentration of Class II Bike Lanes and Class IV Separated Bikeways in Haight Ashbury, North Panhandle, Duboce Triangle, and Inner Mission. The project team also compared high bike commuting rates to census tracts where vehicle ownership is low (Figure 3), to see if there is a correlation. In SoMa, the Mission District, and NoPa, there is some association between households that do not own cars and commuting by bike – likely due to proximity between where people live and where they work. The project team also found that there is some correlation between high-comfort network facilities and neighborhoods with high bike commute rates.

Where in San Francisco is bike commuting low, and why might that be the case?

Neighborhoods with relatively low bike commuting are located in the south and west of the city. In neighborhoods like Bayview-Hunter's Point, Outer Mission, Excelsior, and Lakeshore, low bike commuting may be a result of land use patterns – people simply living too far from their jobs to make commuting by bike an attractive option. In these neighborhoods, bike commuting is low even for households without cars (see Figure 3). In other neighborhoods with low bike commuting such as Chinatown, Twin Peaks, and Pacific Heights, steep slopes are likely a factor.

Table 2: Commute to Work by Bike Citywide vs. Equity Priority Communities

Neighborhood	Percent Commute to Work by Bike (2021)	Percent Bike Commuters that are Women (2021)
Citywide Average	3.1%	30.9%
Bayview-Hunters Point	1.3%	25.6%
Outer Mission/ Excelsior	0.7%	19.3%
Mission District	7.9%	34%
SoMa	4.1%	26.1%
Tenderloin	3.4%	22.1%
Western Addition & Filmore	4.3%	42.5%

A table with the bike commute rates for all San Francisco neighborhoods is provided in Appendix A.

[1] https://www.sfmta.com/getting-around/bike/bicycle-ridership-data/where-are-people-biking

Figure 1: Percent of People in Each Census Tract that Commute to Work by Bike (2021)

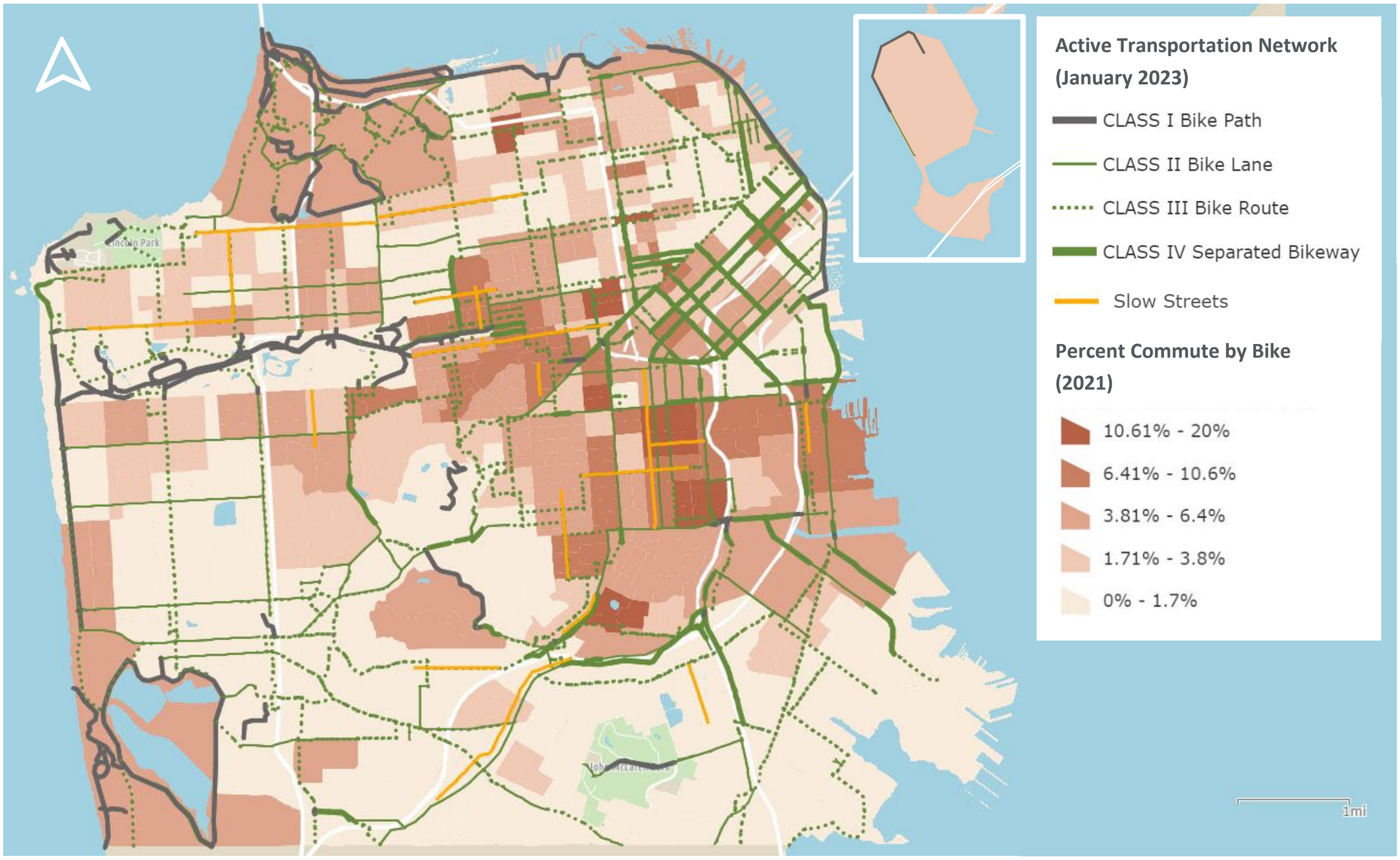
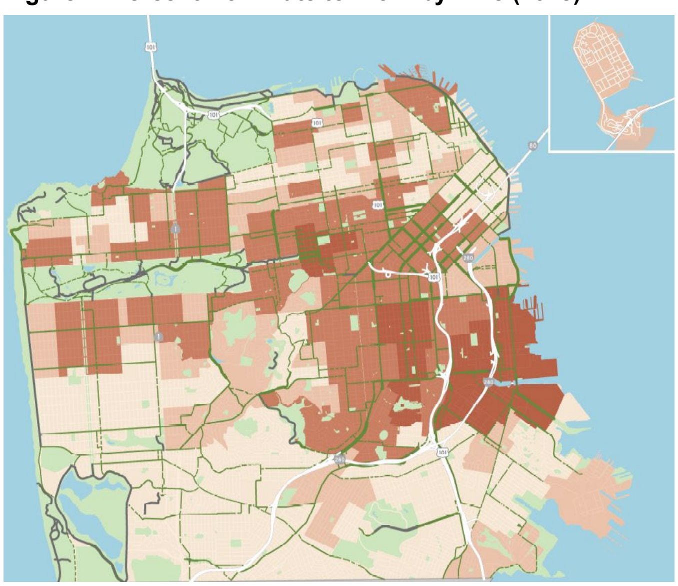


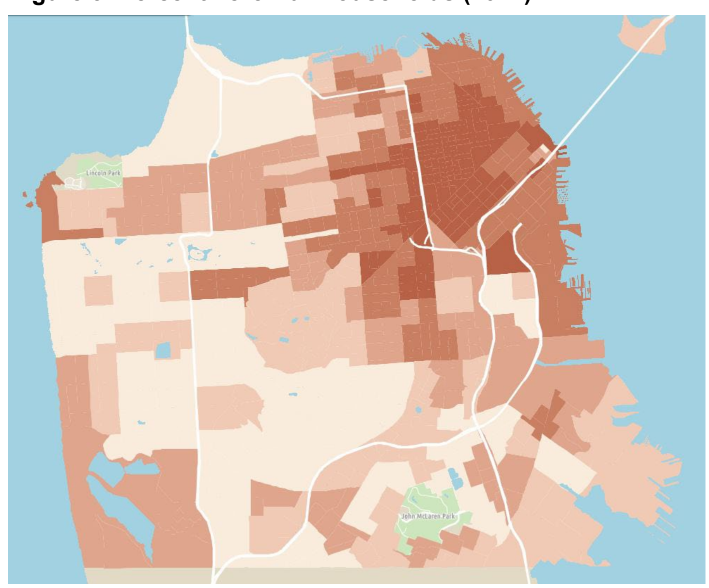
Figure 2: Percent Commute to Work by Bike (2018)



Percent Commute by Bike (%)

- 10.61% - 20%
- 6.41% - 10.6%
- 3.81% - 6.4%
- 1.71% - 3.8%
- 0% - 1.7%

Figure 3: Percent Zero Car Households (2021)



Percent Zero Car Households (%)

- Above 47%
- 28.8% - 46.9%
- 18.1% - 28.7%
- 11.3% - 18%
- 0% - 11.2%

Micromobility Activity

The San Francisco Active Communities Plan addresses biking as well as all other modes that can legally use the active transportation network, including scooters, e-bikes, and electric wheelchairs. To understand where micromobility activity is concentrated, the project team analyzed available 2022 micromobility data including:

- Bay Wheels e-bike volumes throughout the city (data from Lyft)
- Bay Wheels non-electric bike volumes at docking stations (data from Lyft)
- Electric scooter volumes throughout the city (data from vendors including Lime, Bird, and Spin)

It should be noted that available data is only from micromobility providers and does not capture privately-owned bikes and scooters. Figure 4 shows 2022 average annual daily micromobility volumes, including Bay Wheels e-bikes and scooter-share e-scooters. Street-level volumes shown in Figure 4 *do not* include activity for non-electric Bay Wheels bikes, because the manual bikes do not collect routing data. To visualize manual micromobility count data, Figure 4 also shows the number of bikes checked out of each docking station daily in 2022.

Where in San Francisco is micromobility ridership high, and why might that be the case?

The data shows that micromobility activity is concentrated along key commercial corridors and in dense urban areas including Market Street (about 900 trips per day), Valencia Street (about 500 trips), and Polk Street (about 400 trips). The Embarcadero also has a notable concentration of micromobility trips – over 1,800 trips per day. Ridership in the northeast of the city is likely due, in part, to the density of people, jobs, destinations, and tourist activity. Market, Valencia, and Polk are popular routes because they offer direct and convenient links between destinations.

Analysis via the SFMTA Bicycle Network Comfort Index shows that busy commercial corridors are relatively uncomfortable for riders due to high vehicular volumes, a prevalence of double parking, and curbside turnover. But the comfort data also shows that Market, Valencia, and Polk are relatively comfortable, compared to parallel streets. This indicates that micromobility riders avoid uncomfortable commercial corridors in favor of more comfortable, parallel routes – usually routes that have bike facilities. Table 3 shows how comfort and availability of facilities may be influencing where people choose to ride.

Table 3: Micromobility Ridership on Key Commercial Corridors

	Key Corridor	Comfort Score	Facility Type
Instead of riding on…	Van Ness Avenue	Low	None
Riders choose…	Polk Street	Moderate – High	Bike Route and Separated Bikeway
Instead of riding on…	Mission Street	Low - Moderate	None
Riders choose…	Market Street	Moderate	Bike Route and Separated Bikeway
Instead of riding on…	Guerrero Street or Dolores Street	Low - Moderate	None
Riders choose…	Valencia Street	Moderate - High	Bike Lane

Where in San Francisco is micromobility ridership low, and why might that be the case?

When we compare micromobility ridership to the Bay Wheels service area (Figure 5) and the scooter-share service areas (Figure 6), we can see that ridership is surprisingly low in the south and west of the city. The Richmond, Inner Sunset, Balboa Park, and Bayview-Hunters Point all have proximity to bikeshare stations, and fall within the micromobility service areas, but have relatively low volumes (less than 40 average daily rides). Figure 5 shows that Bay Wheels has two special service areas where fees are waived to incentivize e-bike ridership in the south and west of the city[2,3]. Despite this, ridership remains relatively low. Low ridership is likely due, in part, to relatively low network coverage in these neighborhoods, as well as land use patterns – destinations are further away and trips are longer, making micromobility a less attractive option to residents.

A notable exception to this trend is the Great Highway/Great Walkway, which has over 100 micromobility trips per day, despite being located far from bikeshare stations. San Franciscans and tourists are likely renting e-bikes and e-scooters specifically to ride the Great Highway, which suggests that the facility is an attractive recreational spot and key destination for residents and visitors.

What is the relationship between micromobility volumes and the active transportation network?

To understand the relationship between micromobility activity and the existing active transportation network, the project team evaluated volume data against existing infrastructure. Table 4 shows that micromobility volumes are relatively high on Class II Bikeways (Bike Lanes) and Class IV Bikeways (Separated Bikeways), compared to streets with no bicycle facility. It is notable that micromobility volumes are low on the city's Class I Bikeways (Bike Paths), including those in Golden Gate Park and the Presidio. This may be a result of service areas – Golden Gate Park falls outside of all micromobility service areas. In the Presidio, which does allow Bay Wheels bikes, low ridership may suggest that people are choosing micromobility for commuting or transportation purposes, as opposed to recreation.

Table 4: Micromobility Volume by Bike Facility

Bike Facility (Least modal separation to most)	Centerline Miles*	Micromobility Daily Volume (2022)	Micromobility Daily Volume Per Centerline Mile
No Facility	890.5	90,965	102
Class III – Bike Route	115.9	67,136	579
Class II – Bike Lane	90.3	64,701	716
Class IV – Separated Bikeway	29.8	43,666	1,464
Class III - Slow Street	13.8	5,841	425
Class I – Bike Path	40.5	8,794	217

* This analysis uses centerline miles as a core metric. This accounts for the difference between the mileage figures in Table 4 and the mileage figures listed on the SFMTA's website. The figures on the SFMTA website represent lane miles – in locations where the same facility is present on both sides of the street, both sides count toward the total mileage. In this network analysis, streets with the same facility on both sides of the street are *only counted once* toward total mileage. When a street has different facilities on each side of the street, the mileage is counted toward the total mileage *for both* facility types. This analysis uses the active transportation network as it was in January 2023.

[2] 2021 Scooter Permit Letters and Terms & Conditions

[3] Bikeshare Pricing Frequently Asked Questions (FAQ), SFMTA (2022)

Figure 4: Average Annual Daily Micromobility Volumes

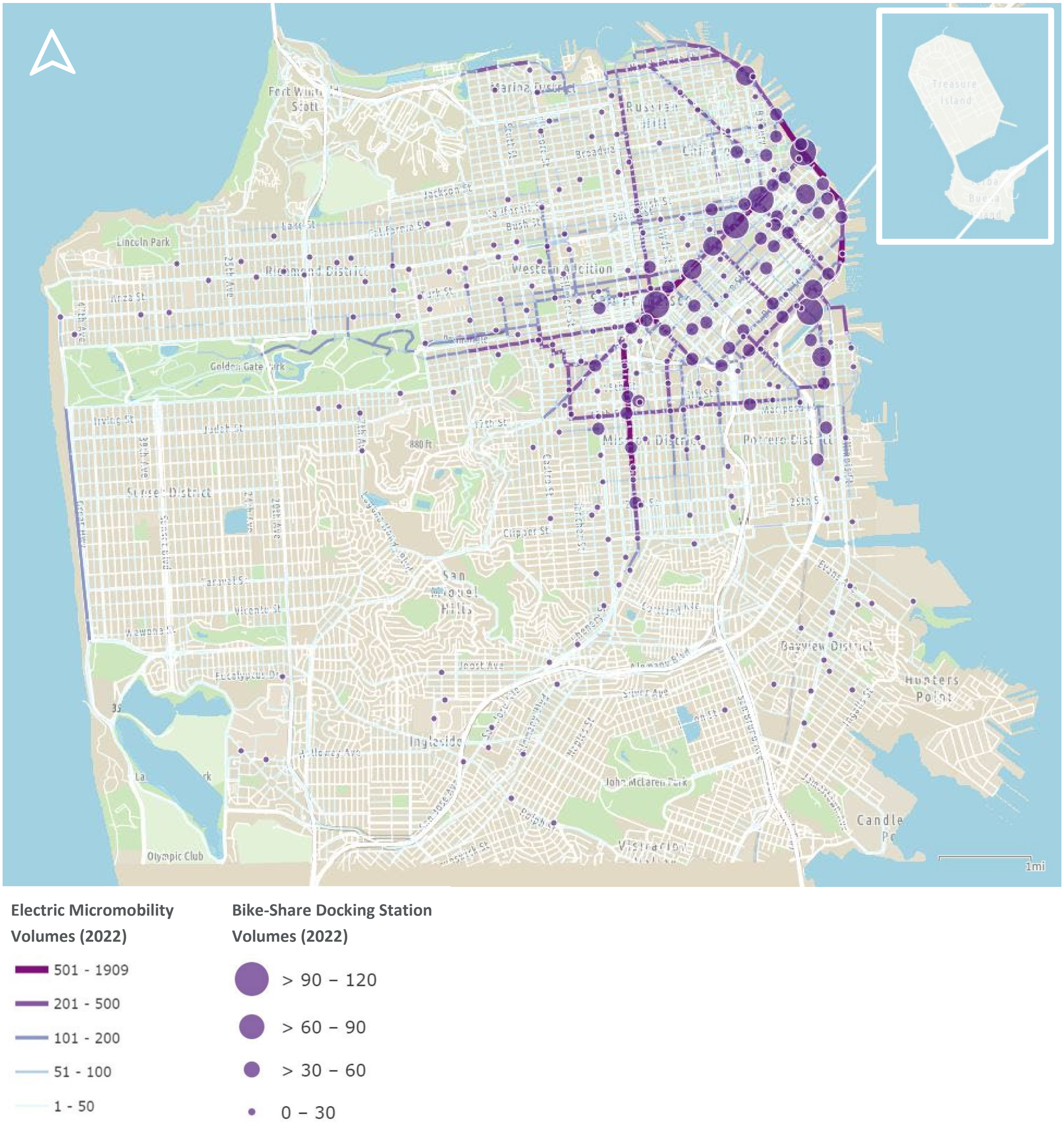


Figure 5: Bay Wheels Service Area and Incentive Pricing

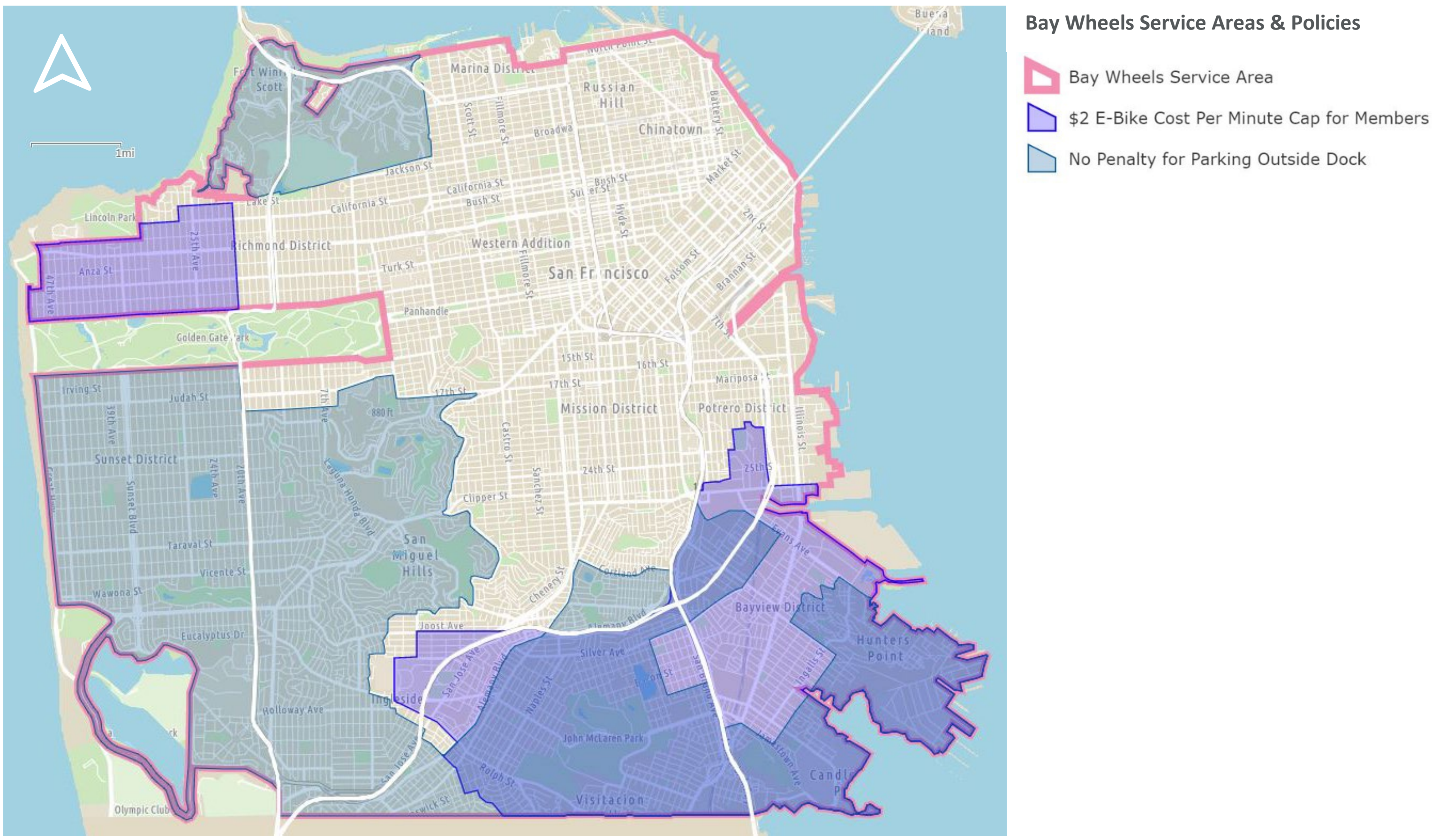
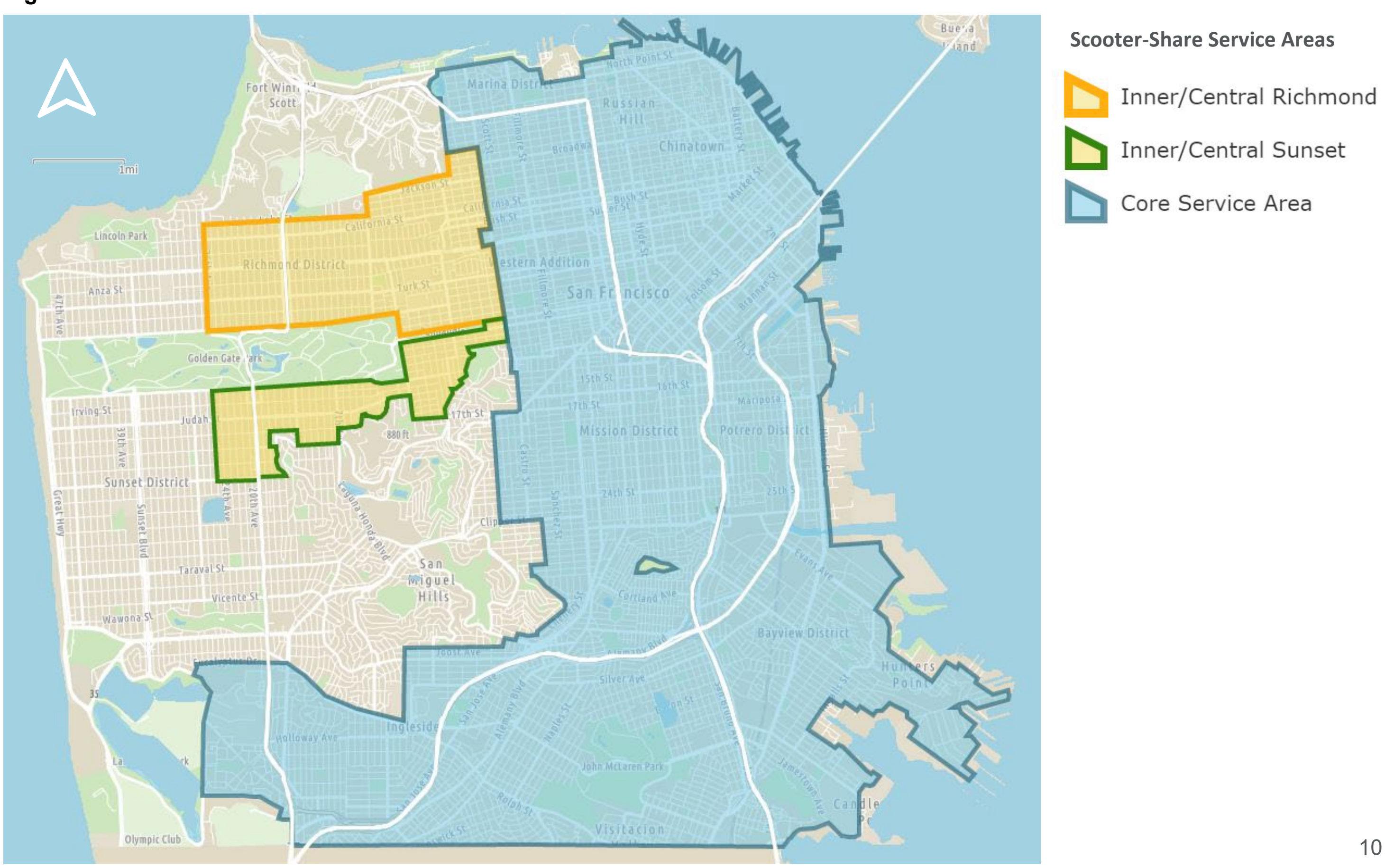


Figure 6: Scooter-Share Service Areas



Bicycle Activity

Bicycle volumes are notoriously challenging to measure at a city-wide scale. The data available for bike volumes in San Francisco include:

- 22 automated counters, which capture both bikes and micromobility devices
- Bike volume counts for 25 slow streets, collected during 2022
- Bike volumes for 13 streets before and after quick-build installations
- Estimated bike volumes for all San Francisco streets from Replica, and activity-based travel demand model

Before modelling citywide estimates, the project team reviewed the SFMTA's automated count data to understand if they show any volume trends. Table 5 shows volumes collected in eleven neighborhoods via 22 automated counters. A regression analysis showed that bikes account for approximately 60% of the trips captured by the counters. The other 40% represents people on micromobility devices riding in bike lanes. The data show that on average, volumes fell by about a third citywide. But not all neighborhoods experienced this trend. Counters in the Inner Richmond, Inner Sunset, Potrero Hill, and Russian Hill capture an increase in volumes between 2018 and 2022.

Table 5: Bike and Micromobility Volumes from Automated Counters (2018 – 2022)

Neighborhood	Number of Counters	Daily Volume 2018	Daily Volume 2022	Percent Change
Bayview	1	779	35	-96%
Bernal Heights	1	210	142	-32%
Inner Richmond	1	136	146	**7%**
Inner Sunset	2	233	278	**19%**
North Beach	1	955	723	-24%
Potrero Hill	1	146	162	**11%**
Russian Hill	1	282	620	**120%**
SoMa	6	8,216	5,023	-39%
The Marina	1	3,096	2,283	-26%
The Mission	3	2,454	1,964	-20%
Western Addition	4	3,223	2,938	-9%
TOTAL	**22**	**19,730**	**14,314**	**-27%**

Table 6 shows volumes on streets before and after they received quick-build projects. Streets that received quick-build projects in 2022 all saw an uptick in bike trips. Across all 13 project locations, bike trips increased by a total of 32%. Some quick-build projects did not install new bikeways, but the corresponding safety and traffic calming improvements may have influenced changes in bike trips.

Table 6: Bike Volumes Before and After Quick-Build Installations (2022)

Quick Build Project	Implementation Date	Daily Bike Volumes		
		Before	After	Change
7th Street Safety Project (Phase 1)	5/17/2022	369	372	1%
8th Street Safety Project	5/17/2022	539	576	7%
Folsom Near-Term	1/18/2022	373	444	19%
Polk Streetscape	5/19/2022	471	480	2%
2nd Street	4/19/2022	401	529	32%
Masonic Streetscape	8/18/2022	23	112	387%
Leavenworth Quick-Build (no new bikeways)	6/21/2022	22	36	64%

Quick Build Project	Implementation Date	Daily Bike Volumes		
		Before	After	Change
Golden Gate Ave Quick-Build	5/21/2022	31	52	68%
Valencia (north) Quick-Build	5/19/2022	642	1148	79%
6th Street Quick-Build (no new bikeways)	9/19/2022	146	157	8%
Taylor Quick-Build (no new bikeways)	6/19/2022	17	52	206%
Indiana Quick-Build	10/19/2022	66	94	42%
Fell Street	8/20/2022	790	1087	38%
TOTAL		**3,890**	**5,139**	**32%**

Table 7 shows bike volumes collected for 25 slow streets in 2022. Slow Streets with the highest volumes include Shotwell Street, Clay Street, Lake Street, and Page Street. Shotwell Street and Page Street are located in some of San Francisco’s most dense urban neighborhoods. Together, Lake Street and Clay Street provide a key east-west connection across the city. Excelsior Avenue, Arkansas Street, Mariposa Street, Somerset Street, and Tompkins Avenue have some of the lowest bike volumes of all the Slow Streets. These streets are concentrated in the southeast of the city in neighborhoods with low bike volumes overall.

Table 7: Bike Volumes on Slow Streets (2022)

Slow Street (2022)	Avg. Day* Observed Bicycle Volume (24-Hr)	Standard Deviations from Mean	Volume**
Excelsior Avenue	5	-0.697	Low
Arkansas Street	10	-0.665	Low
Mariposa Street	10	-0.665	Low
Somerset Street	20	-0.603	Low
Tompkins Avenue	20	-0.603	Low
Ortega Street	30	-0.541	Moderate
Duncan Street	40	-0.478	Moderate
Noe Street	40	-0.478	Moderate
41st Avenue	50	-0.416	Moderate
Arlington Street	50	-0.416	Moderate
Minnesota Street	60	-0.353	Moderate
20th Avenue	70	-0.291	Moderate
Chenery Street	70	-0.291	Moderate
Golden Gate	80	-0.228	Moderate
Kirkham Street	80	-0.228	Moderate
Lombard Street	100	-0.104	Moderate
Pacific Avenue	100	-0.104	Moderate
Cabrillo Street	110	-0.041	Moderate
20th Street	120	0.021	Moderate
23rd Avenue	120	0.021	Moderate
Sanchez Street	120	0.021	Moderate
Shotwell Street	130	0.084	High
Clay Street	250	0.833	High
Lake Street	550	2.705	High
Page Street	680	3.517	High

*Day = average of the weekday and weekend volumes

**High = 0.5 Standard Deviations (STD) above the mean; Moderate = Between 0.5 STD and -0.5 STD; Low = Greater than -0.5 STD

Combined Bicycle and Micromobility Activity

To tell a cohesive story of active transportation activity in San Francisco, the project team modelled combined bicycle and micromobility volumes for San Francisco's active transportation network. The model combines micromobility volumes with bike volumes estimated by Replica, an activity-based travel demand model. Because Replica's bike count data is only moderately reliable, the project team calibrated the volumes against actual counts collected by the SFMTA. Calibrated against 31 manual counts, the project team found a linear regression model using the sum of both network-level volumes performed the best (i.e., produced volumes that aligned most closely with manual count data):

$$Bike\ Volume = 165.6 + 0.6 * (micromobility\ volume + Replica\ volume)$$

The results of the modelled volumes are shown in Figure 7. Actual count data collected from 22 manual counters is also shown in Figure 7.

Figure 7: Modelled Bike and Micromobility Volumes and Manual Counter Volumes

Network Performance: Volumes vs Quality

The network analysis is built on the assumption that there is a relationship between ridership volumes, and the quality, connectivity, and coverage of the network. Positive associations between volumes and network quality may indicate that the network is working well. Negative associations may indicate that the network is underperforming, could be improved, or that there is a mismatch between rider need, facility type, and surrounding conditions.

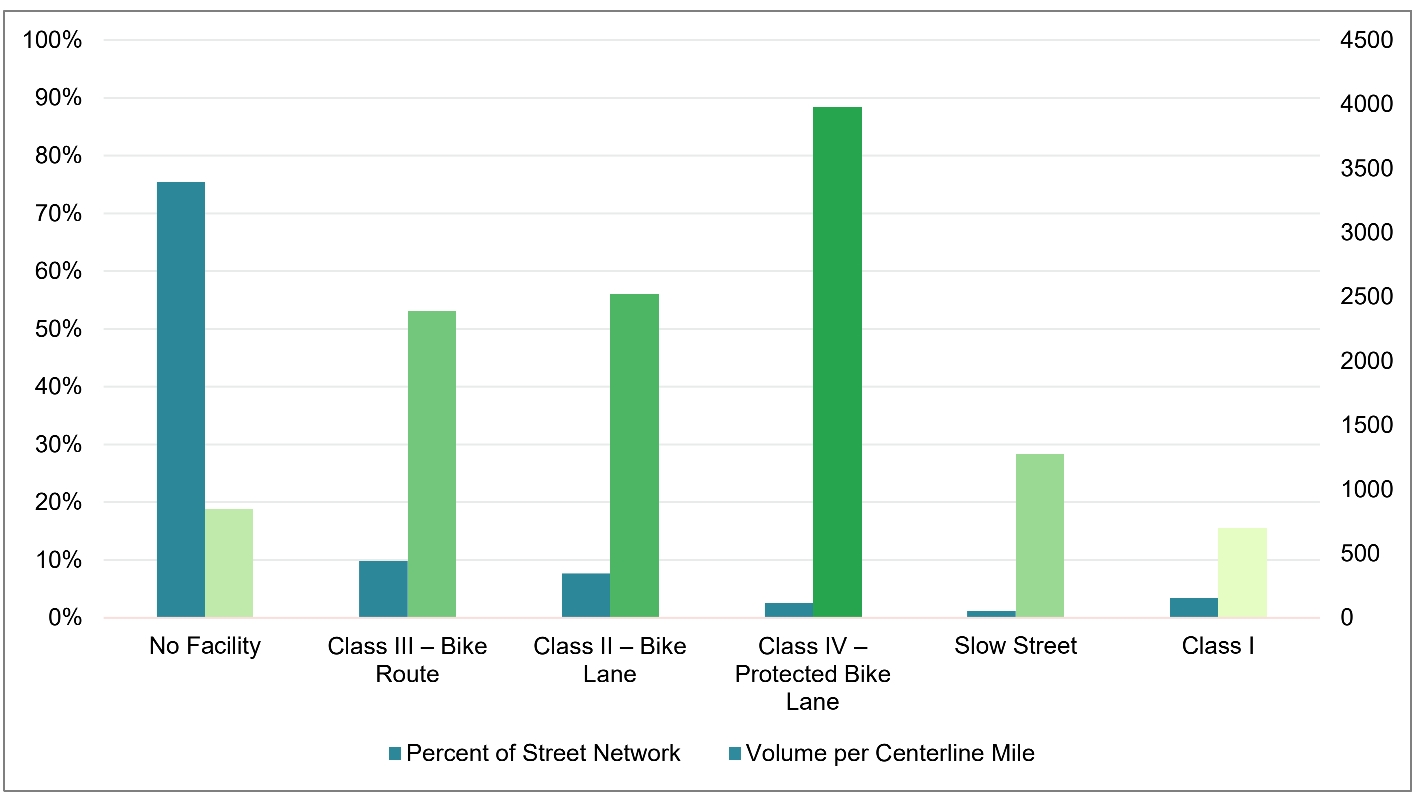
Most trips in San Francisco take place off-network because most streets in the city do not have bike facilities. There are simply more miles of off-network streets than any of the facility types. But when volume is normalized by centerline mileage, the data show that there is an association between ridership and quality facilities. Facilities with protection from cars – protected bike lanes – have the highest ridership per centerline mile than any other facility type. Ridership per centerline mile increases as protection from cars increases.

The exception to this finding is Class I Bike Paths. This is likely because bike paths in San Francisco are concentrated in the city's parks; Bike paths through the Presidio, Golden Gate Park, and Lake Merced may not offer quick and convenient connections to destinations and are more suitable for recreation than for daily transportation or commuting. Golden Gate Park is also outside of the shared micromobility service area which could explain lower volumes on those paths.

Table 8: Bike and Micromobility Volumes by Facility

Bike Facility (Least modal separation to most)	Centerline Miles*	Bike+ Micromobility Volumes (2022)	Bike+ Micromobility Volume Per Centerline Mile (2022)
No Facility	890.5	750,494	843
Class III Bikeway – Slow Street	13.8	17,568	1,273
Class III Bikeway – Bike Route	115.9	277,073	2,391
Class II Bikeway – Bike Lane	90.3	227,938	2,524
Class IV Bikeway – Separated Bikeway	29.8	118,554	3,978
Class I Bikeway – Off-Street Bike Path	40.5	28,162	695

Figure 8: Facility Type as Percent of Street Network vs. Volumes per Centerline Mile



High-Quality Network Performance

The project team compared bike and micromobility volumes to network quality and facility type. Network quality is defined here as streets with:

- Class IV Separated Bikeways,
- Class I Shared-Use Paths,
- Slow Streets, and
- Car-Free Streets (such as JFK and the Great Highway/Walkway).

Figure 9 shows volumes on the network's high-quality facilities. Darker lines represent high volumes and indicate places where the high-quality network is performing well. Lighter lines represent low volumes and indicate places where the high-quality network may be under-performing. The highest performing network segments are concentrated in SoMa, and on many of the city's Slow Streets. The lowest-performing network segments are scattered throughout the city and need to be evaluated on a case-by-case basis to understand why volumes may be low, and how these facilities could be improved.

Class IV Separated Bikeway Performance

Overall, Class IV bike facilities in the Financial District and SoMa have the highest volumes in the city, likely due to the density of land uses, people, housing, jobs, and destinations. The project team examined the low-performing protected bike lanes to understand what might be discouraging ridership. The following examples can offer lessons learned for implementation and maintenance of facilities throughout the city:

- On Turk Street and Golden Gate Avenue in the Tenderloin, low volumes may be due to the *barrier type not being appropriate for surrounding activity*. Both streets have flex posts which are often ignored or damaged. On both streets parking in the bike lane is common, curbside turnover is high, and there are frequent 311 reports of debris in the bike lane.
- On Alemany Boulevard and San Jose Avenue in St Mary's Park/ Glen Park/ Mission Terrace, barrier type may also play a role. In these cases, vehicular volumes and speeds are high, the flex posts may not offer riders the separation they need to feel comfortable. Where K-rail is present on both streets, other factors such as challenging intersections or challenging network connections may also play a role.
- In Hunters Point, Evans Avenue and Cargo Way both have concrete barriers separating riders from vehicular traffic. In these locations, low ridership is likely due to other factors, such as surrounding land use (low density), long distances from destinations, and overall network quality. In particular, the Class IV segments are surrounded by lower-comfort Class III bike routes. Enhancements to surrounding facilities could encourage more ridership throughout the neighborhood.

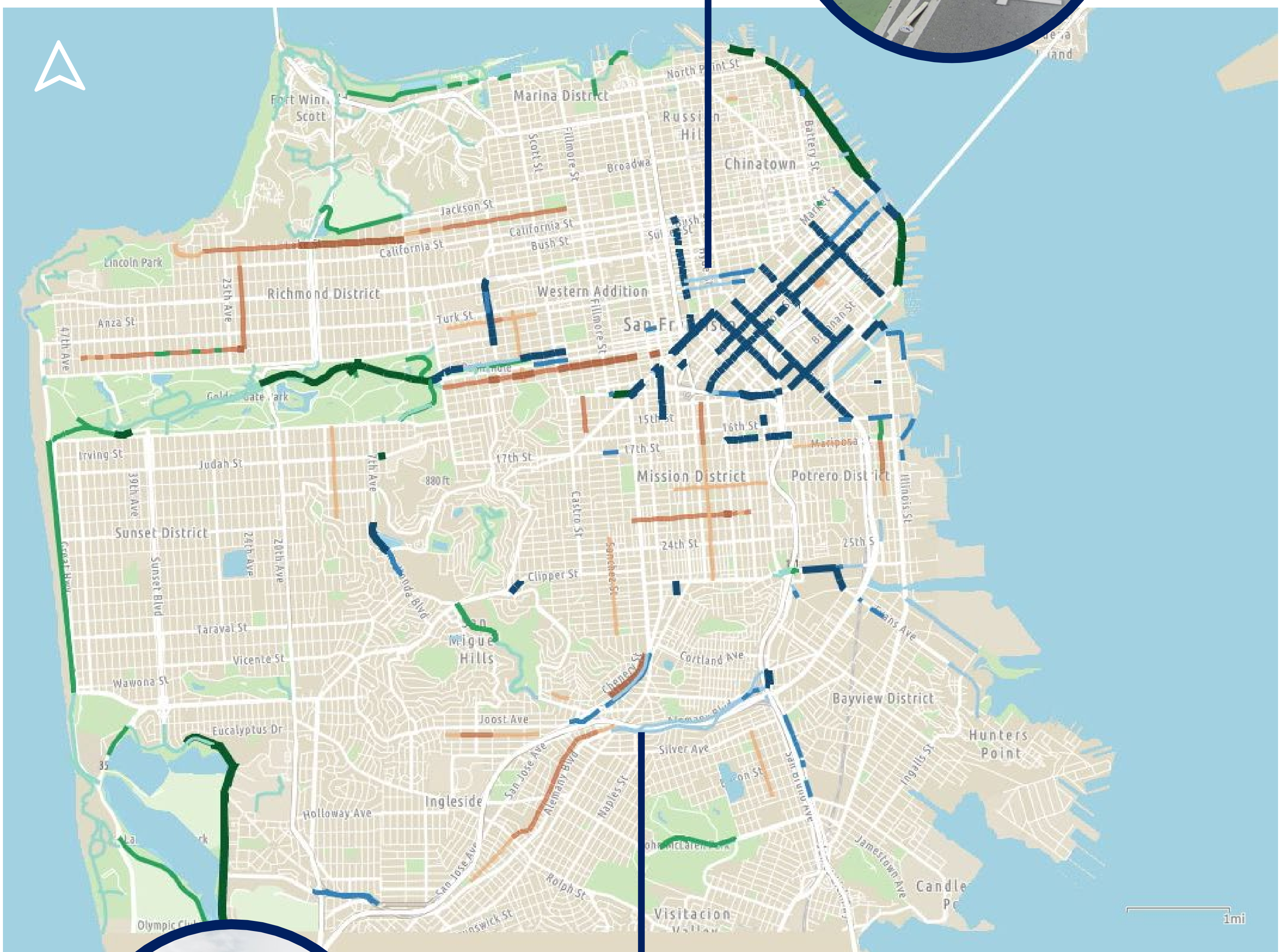
Class I Bike Path (and Car-Free Streets) Performance

For Class I bike paths, the high-performing segments include Car-Free JFK in Golden Gate Park, Lake Merced Boulevard along Lake Merced, Mason Boulevard in the Presidio along Crissy Fields, and segments along the embarcadero and Fisherman's Warf, possibly due to the flat, accessible paths and proximity to recreational sites and tourist attractions. Low volume Class I paths include O'Shaughnessy Boulevard in Glen Canyon Park and Twin Peaks Boulevard in Twin Peaks, possibly due to the steep hills.

Slow Streets Performance

Evaluating the performance of Slow Streets requires a slightly different approach. Low bicycle and micromobility volumes may not be an indication that the Slow Street is under-performing. Particularly in low-density neighborhoods, low volumes may be appropriate for the neighborhood context. On low-volume Slow Streets, community feedback is required to understand whether there are specific reasons why people choose not to ride on the street. However, Slow Streets with particularly high bicycle and micromobility volumes can be an indication of high-demand and high-need for safety infrastructure. The Slow Streets that are estimated to have the highest volumes include Lake Street and Page Street. It should be noted that Slow Streets serve other purposes than bicycle & micromobility trips, and as such should not be judged by that criteria alone. This estimation is consistent with manual bike counts on slow streets (Table 7).

Figure 9: High Quality Network Volumes



Bike Lanes and Bike Route Performance

Figure 10 shows volumes on the rest of the network, including all Class II Bike Lanes and Class III Bike Routes. The project team classified Class II and Class III facilities with high volumes as “over-performing”. On these streets, high volumes indicate that despite relatively low separation from cars, riders still choose these routes due to some combination of convenience, necessity, and comfort. Over-performing streets with Class II Bike Lanes and/or Class III Bike Routes include:

- Arguello Boulevard and Anza Street in the Richmond
- Sutter Street, Post Street, and McAllister Street which run parallel from Market Street towards NoPa/ South Pacific Heights
- North-South routes in the Sunset including 20th Avenue and 34th Avenue
- Valencia Street, Folsom Street, and Harrison Street in the Mission
- Columbus Avenue from the Financial District to North Beach
- Stockton Street in Chinatown
- Segments of Market Street, Page Street, Polk Street, 11th Street in downtown San Francisco
- Ocean Avenue in Ingleside/ Balboa Terrace

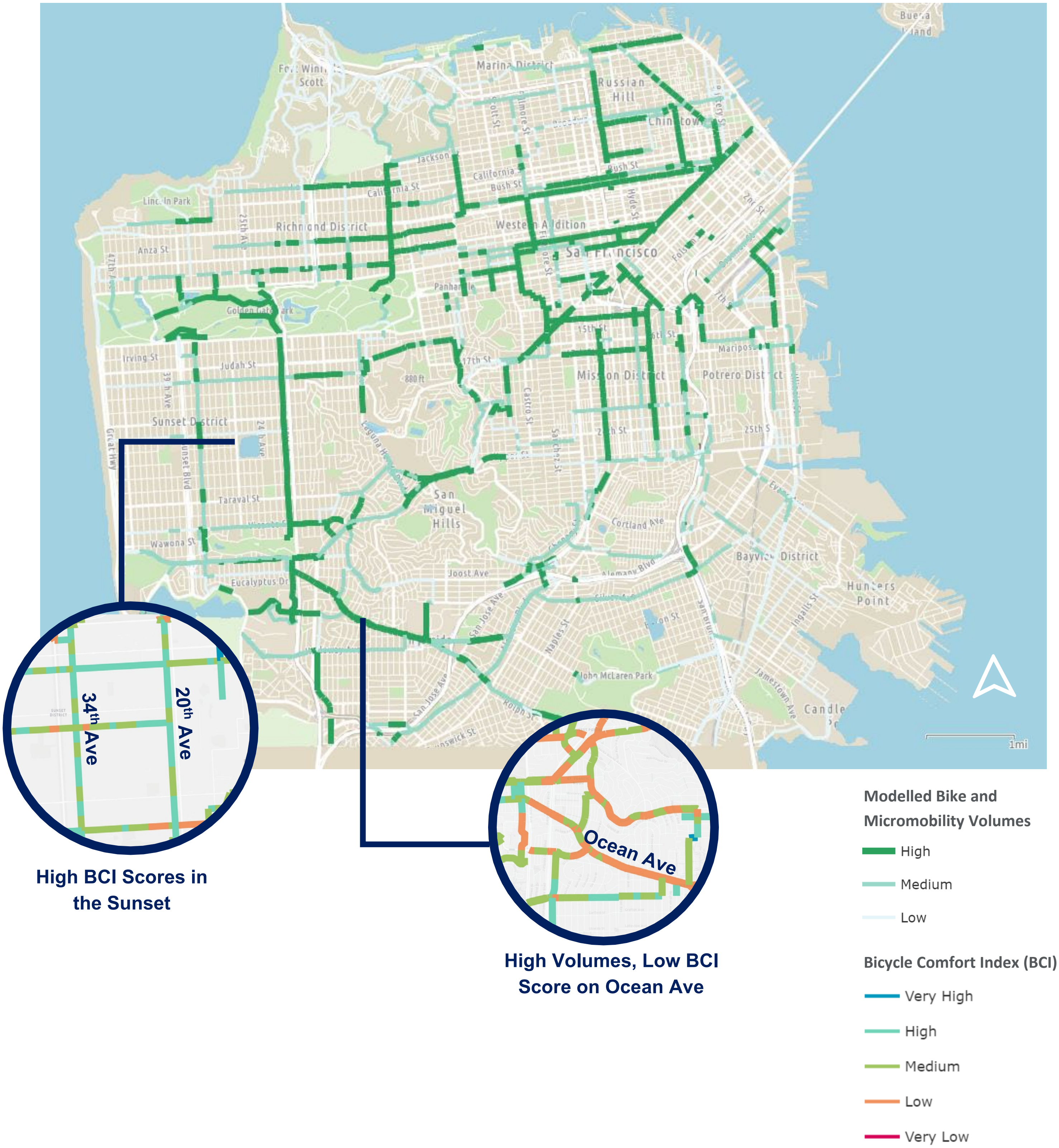
Over-performing streets need to be evaluated on a case-by-case basis to understand what is driving volumes, and whether high volumes indicate a gap in the network. In the dense urban center (on streets like Market and Valencia), high volumes are likely a result of surrounding density, as well as connections to higher-quality facilities. Bike and micromobility trips in these neighborhoods likely traverse multiple facility types of varying quality and comfort.

In lower-density neighborhoods like the Richmond, the Sunset, Ingleside, and Balboa Terrace, high ridership may be an indication of demand for bike facilities. But it may also be an indication that Class II and Class III facilities *are working* in these neighborhoods, and are appropriate facilities for the surrounding land use and traffic contexts. The Bicycle Comfort Index inset in Figure 10 shows 20th Avenue and 34th Avenue in the Sunset are high-comfort streets and may already have appropriate facilities. Public input is necessary to confirm this assumption.

Ocean Avenue is a good example of a street with relatively high ridership, despite having a Class III Bike Route and a relatively low bicycle comfort score. In addition, volumes on Ocean Avenue drop substantially west of 19th Avenue, even though the facility type upgrades to a Class II Bike Lane. Taken together, these factors may indicate a network gap and the need for an improved facility on Ocean Avenue. Public input is necessary to confirm this assumption.

Class II and Class III facilities with low ridership may be an indication that network upgrades are necessary. Ridership is relatively low on facilities throughout Bayview-Hunters Point, on the east-west corridors in the Sunset, and on Brannan Street in SoMa. Further analysis is necessary to determine the reason for low ridership in each case.

Figure 10: Bike Lane and Bike Route Volumes

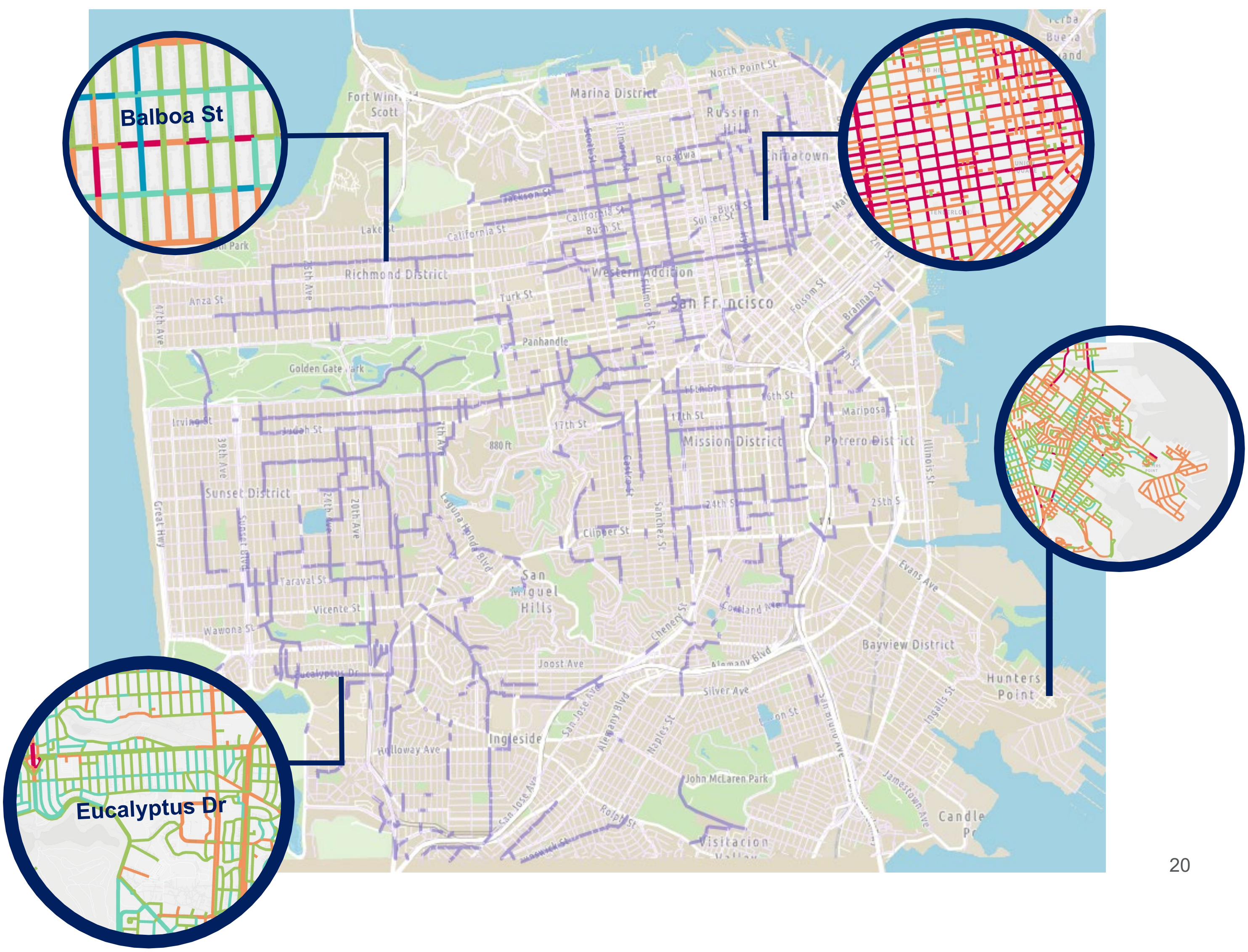


Off-Network Performance

Figure 11 shows modelled volumes outside of the active transportation network. Off-network streets are critical part of how San Franciscan's get around. In fact, most bike and micromobility trips take place off-network. To understand *why* volumes are high or low on certain streets (or in certain neighborhoods), the project team looked at the volume data alongside the Bicycle Comfort Index (BCI). BCI scores are shown as insets on Figure 11. It can be difficult to determine the precise reason for ridership trends, but the following correlations can be useful markers of infrastructure issues or network gaps:

- **High-Volumes, Low-Comfort:** Where volumes are high, but the BCI score is low, it may indicate that there is a need for infrastructure enhancements. Examples include Balboa Street and Clement Street in the Richmond, Yerba Buena Avenue in Sherwood Forest/ Monterey Heights, 24th Street in the Mission, and most of the off-network streets in the Tenderloin.
- **High-Volumes, High-Comfort:** Where volumes are high, and the BCI is high, it may indicate that the current infrastructure conditions are working. Examples include 42nd Avenue in the Sunset, Eucalyptus Drive in Lakeshore, Cabo Street in the Mission, and Eddy Street in Western Addition.
- **Low Volumes, Low Comfort:** Where volumes are low, and comfort is low, it may indicate that there are issues discouraging riders from choosing a particular route. Many parts of the Bayview-Hunter's Point neighborhood fall into this category.
- **Low-Volumes, High Comfort:** Low volumes where comfort is high may simply reflect a low population and land use context. In high-density neighborhoods, low volumes *could* indicate an issue that is preventing riders from choosing a specific route. It may also be the case that there are on-network facilities or more convenient routes nearby. For example, in SoMa, off-network volumes are notably low, but on-network volumes are some of the highest in the city.

Figure 11: Off-Network Volumes



Network Performance: Volumes vs Coverage

The project team calculated network coverage for each neighborhood in San Francisco. Network coverage is defined here as the percent of centerline miles in a neighborhood that have bicycle facilities. Figure 12 shows the network coverage overlaid with network volumes on the bike network. Table 9 provides a guide for reading the map, and summary of locations that are over- or under- performing. When volumes are low, but network coverage is relatively high, it may be an indication that the network is under-performing due to factors like land use (long distances between key destinations), connectivity (poor connections to destinations outside of the neighborhood), or network quality (such as lack of protected from cars). Low volumes may also simply be the result of low population density.

Neighborhoods where volumes are low relative to coverage include Bayview-Hunters Point, Mission Terrace/Cayuga/Outer Mission, and the east-west corridors in the Sunset District. As part of network development, the project team will assess the precise reason for poor network performance, and identify appropriate policy, program, or infrastructure recommendations.

Note that this metric should not be used to evaluate network performance in parks. Be definition, parks have relatively few streets or centerline miles, and relatively high network coverage. As a result, San Francisco parks (The Presidio, Golden Gate Park, Lakeshore, McLaren Park) appear to be "under-performing".

Table 9: Network Performance Based on Coverage and Volumes

Network Performance	Volumes* vs Network Coverage	Map Symbology	Example Neighborhoods and Streets
Over-Performing	Volumes are high, relative to network coverage	Lines are darker than the polygon	• Northeast San Francisco • The Mission District • Inner Richmond • Inner Sunset • Balboa Terrace/ Ingleside • North-South Streets in the Sunset • The "Wiggle"
Under-Performing	Volumes are low, relative to network coverage	Lines are lighter than the polygon	• Bayview-Hunters Point • Mission Terrace/ Cayuga/ Outer Mission • East-West Streets in the Sunset

*Modelled (combined) bike and micromobility volumes

Figure 12: Network Coverage vs Network Volumes

Appendix A: Neighborhood-Level Network Performance Metrics

Table A-1: Neighborhood-Level Network Performance

	Network Coverage	Network Quality	Volumes		
Neighborhood	**Percent of Centerline Miles with Bike Facilities**	**Percent of Lane Miles with High Quality Facilities (Class I, Class IV, Slow Street, or Car-Free Street)**	**Bike Commute Mode share (2021)**	**Percent Bike Commuters that Are Female (2021)**	**Modeled Average Daily Bike and Micromobility Volumes Per Centerline Mile (2022)**
Citywide Average	24%	8%	3.1%	30.9%	NA
Six Focus Equity Priority Communities					
Bayview-Hunters Point	23%	5%	1.3%	25.6%	761
Outer Mission/ Excelsior	19%	4%	0.8%	23.1%	1,223
Mission District	30%	8%	7.9%	23%	4,059
SoMa	36%	22%	4.1%	26.1%	5,265
Tenderloin	28%	10%	3.4%	22.1%	6,104
Western Addition/ Filmore	19%	0%	4.3%	42.5%	3,268
Other Neighborhoods					
Bernal Heights	16%	6%	5.7%	39.1%	1,426
Castro/Upper Market	19%	2%	4.2%	29.0%	2,592
Chinatown	18%	0%	0.4%	0.0%	5,139
Financial District/South	39%	12%	2.7%	29.9%	3,672
Glen Park	25%	13%	2.4%	54.8%	1,107
Golden Gate Park	55%	33%	0.0%	100.0%	1,382
Haight Ashbury	24%	9%	6.8%	37.6%	3,696
Hayes Valley	34%	7%	8.1%	28.6%	4,013
Inner Richmond	19%	0%	4.2%	25.8%	3,184
Inner Sunset	11%	2%	4.2%	26.0%	1,565
Japantown	40%	0%	4.7%	0.0%	4,853
Lakeshore	52%	25%	0.7%	18.7%	1,158
Lincoln Park	60%	25%	0.0%	100.0%	810
Lone Mountain/USF	38%	11%	6.0%	35.5%	4,053
Marina	18%	4%	2.9%	11.0%	2,263
McLaren Park	42%	23%	0.0%	100.0%	419
Mission Bay	31%	13%	2.1%	23.4%	2,927
Nob Hill	27%	0%	2.8%	43.7%	4,702
Noe Valley	19%	3%	4.2%	41.1%	1,715
North Beach	14%	3%	3.4%	14.4%	2,874
Oceanview/Merced/Ingleside	19%	3%	0.8%	27.8%	1,314
Outer Richmond	21%	4%	2.4%	35.1%	2,164
Pacific Heights	14%	5%	1.7%	10.5%	3,662
Portola	21%	9%	0.8%	0.0%	764
Potrero Hill	18%	6%	6.9%	27.5%	2,175
Presidio	58%	25%	3.9%	30.5%	696
Presidio Heights	24%	6%	1.5%	100.0%	3,353
Russian Hill	21%	2%	3.7%	44.3%	3,473
Seacliff	33%	1%	0.0%	100.0%	2,097
Sunset/Parkside	20%	1%	2.1%	24.8%	1425
Treasure Island	7%	5%	3.1%	40.0%	No Data
Twin Peaks	14%	7%	1.5%	0.0%	631
Visitacion Valley	7%	0%	0.1%	0.0%	259
West of Twin Peaks	19%	3%	1.4%	36.8%	1,166

Notes on Coverage Methodology:

- Network coverage was calculated as [roadway centerline miles/ facility centerline miles]
  - Network Coverage = 289/ 1,165 = 24.8%
- Total Roadway Centerline Miles = 1,165
  - For dual-carriageway streets, both carriageways are counted toward the total centerline mileage. There are 95 miles of dual carriageway streets in San Francisco = 189 total centerline miles of dual carriageways.
  - For all other streets, including one-way streets, centerline miles are only counted once.
- Total Facility Centerline Miles = 289
  - For streets with the same facility on both sides, centerline miles are counted once.
  - For dual carriageway streets, centerline miles are counted for both sides. This shouldn't inflate the percent coverage because centerline road miles (the denominator) are also counted twice.
  - For streets with different facilities on two sides, counting centerline mile twice. 15 centerline miles of roads have different facilities on two sides of the street. Therefore, total is inflated by 15 miles.
    - If we reduce the total mileage by 15 to remove this inflation, the total citywide coverage is 23.5%
  - For streets with facility only on one side, centerline miles are counted once.
- Network Coverage = 289/ 1,165 = 24.8%
  - Note that Class I facilities are concentrated in parks where roadway centerline mileage is relatively low. In parks (the Presidio, Lincoln Park, Golden Gate Park, and Lakeshore), the network coverage is very high. In addition, Class I paths tend to be concentrated outside of the areas typically though of as the city's street network.
  - Including Class I facilities in the total facility coverage could make overall coverage appear inflated.
  - If we remove Class I facilities from the equation:
    - Total centerline miles *excluding* Class I = 248
    - Citywide coverage *excluding* Class I = 21%