Existing Conditions Report

SamTrans Bus Stop Improvement Plan

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Introduction

The SamTrans Bus Stop Improvement Project (BSIP) identifies bus stop features and amenities that SamTrans riders, local governments, and community members value, and lays out a plan for improving bus stops across the SamTrans network. This report provides the results of the 2022 bus stop inventory covering 1,871 stops across 21 cities and towns within the SamTrans service area in San Mateo, San Francisco, and Santa Clara Counties, as well as unincorporated areas across San Mateo County. With stops serving areas from the Financial District of San Francisco to rural coastside regions of San Mateo County, SamTrans operates transit service across a large range of environments. This variety is reflected in the diversity of bus stop amenities and operational conditions observed at stops across the service area.

This report is designed to provide a high-level overview of the inventory conducted, examining existing conditions of SamTrans bus stops across jurisdictions. For added context, comparisons with best practices from across the industry are provided. A Bus Stop Improvement Plan Data Dashboard (Dashboard), a web-based geodatabase, was also prepared to provide a more detailed understanding of existing bus stop conditions. The Dashboard is available online. The Dashboard allows users to aggregate the data based on numerous contextual and site-specific factors at various levels of geographic scale and can be used for more detailed explorations of the data.

Overview of the Inventory Process

Bus stops were inventoried utilizing a web-based GIS platform, allowing for streamlined data entry of the 20 attributes collected at all 1,871 stops – collectively over 37,000 datapoints. Aerial imagery and Google Streetview were predominantly used to identify characteristics at each stop. All datapoints collected throughout the inventory were broken into two categories: rider experience factors and bus operations factors. Contextual factors such as census data and observed speeds on street segments was layered on top of the bus stop inventory. Table 1 summarizes the rider experience and bus operations factors and Table 2 summarizes the contextual factors collected as part of the inventory process.

Table 1: Summary of Inventoried Bus Stop Attributes

Factor	Attribute (Quantity/Presence of)
Rider Experience (Amenities)	Standard pole & sign
	Real-time information
	System map
	System schedule
	Shelter
	Bench
	Simme seat

Factor	Attribute (Quantity/Presence of)
	Trash receptacle
	Crosswalk
	Crosswalk control type
	Sidewalk
	Potential landing pad obstructions
	Curb cuts/ramps
Bus Operations (Stop Typology)	Location
	Position
	Stop length
	Bus Pad
	Red curb
	Parking restrictions
	Driveway conflicts

The inventory of stops underwent a quality control process where staff sampled stops from across the system to help ensure that inventory attributes were accurate and aligned with overall assumptions. For stops lacking sufficient aerial imagery or Streetview data, a field verification of attributes was conducted by SamTrans staff.

Once the inventory was complete, contextual data was also integrated into the database and joined to individual bus stops. These factors provide perspective on the surrounding environment of the bus stop. Ridership was also included to allow for existing stop utilization to be considered. Ultimately, these factors can be used to guide the prioritization of future stop improvements or modifications.

Table 2: Summary of Contextual Factors Considered

Data Layer	Description	Source
SamTrans Stops	Bus stops effective 8/7/22 (Reimagine SamTrans Phase 01 Roll-out)	SamTrans
SamTrans Ridership	Average daily ridership (Ons+Offs) for September 2022	SamTrans
Census Places	Census-designated communities.	U.S. Census
Roadway Classification	Roadway classification by segment as defined by OpenStreetMap	OpenStreetMap

Data Layer	Description	Source
Injury Collisions	Injury collisions by mode throughout the service area from 2017-2021	Transportation Injury Mapping System/ Statewide Integrated Traffic Records System
Existing Bike Facilities	Existing bike facilities by classification	C/CAG Bike Plan
Daily Average Observed Speeds	Daily average observed speeds on all OpenStreetMap segments with available data throughout the service area. Data collected in 2019.	Wejo
Activity Density	The sum of population and jobs by census block group	American Community Survey 2019 5-Year Estimates
Vulnerability Index Tracts	Heat index scores in alignment with the SamTrans Adaptation and Resilience Plan	SamTrans
Equity Priority Areas	SamTrans Equity Priority Areas, as used in the Reimagine SamTrans effort	SamTrans

A detailed methodology memorandum is included as Appendix A.1.

Amenities and Rider Experience

Bus stops are a rider's first impression of a transit agency and where riders may spend a significant portion of their overall transit journey time. As documented in industry best practice documents such as TransitCenter's *From Sorry to Superb: Everything You Need to Know about Great Bus Stops* and NACTO's *Transit Streets Design Guide*, providing quality rider amenities is critical to improving customer satisfaction and boosting ridership, including providing shade, shelter, lighting, wayfinding, and a place to sit or lean. These amenities can reduce riders' perceived wait times for buses simply by making the wait feel more comfortable and safe.

Bus stops are also a part of the public realm. Their appearance can attract or deter potential riders since bus stops may be the only interaction that members of the community who don't ride the bus have with a transit agency.

A snapshot of existing amenities provided by route type (standard and school-oriented) are provided in the sections below. Further details and granularity regarding bus stop amenities can be found in the Bus Stop Improvement Plan Data Dashboard available online.

Bus Stops Serving Standard Routes

Most standard bus stops do not have any amenities beyond a pole and sign. Systemwide, about 16 percent of bus stops include a shelter, 16 percent of stops include a bench, and 20 percent include a trash receptacle. Less than ten percent of stops include system maps, while very few include schedules or real-time arrival information. Table 3 indicates the percentage of stops with the quantified amenity by jurisdiction for standard (non-school-oriented) routes.

Table 3: Standard Routes Rider Amenities Summary

Jurisdiction	Total # of Stops	Pole & Sign	Shelter	Bench[1]	Simme Seat	Trash Receptacle	Real-Time	System Map	System Schedule
Atherton	12	100%	8%	25%	0%	25%	0%	8%	0%
Belmont	33	94%	18%	30%	0%	36%	0%	6%	0%
Brisbane	12	100%	67%	8%	0%	67%	0%	33%	0%
Burlingame	46	96%	28%	48%	0%	52%	0%	13%	0%
Colma	11	100%	45%	27%	0%	64%	0%	36%	0%
Daly City	198	95%	20%	9%	0%	20%	0%	12%	0%
East Palo Alto	53	96%	15%	13%	0%	30%	0%	4%	0%
Foster City	26	96%	12%	0%	4%	12%	0%	8%	0%
Half Moon Bay	37	89%	11%	11%	0%	19%	0%	3%	0%
Menlo Park	50	98%	18%	22%	0%	36%	0%	20%	0%

Jurisdiction	Total # of Stops	Pole & Sign	Shelter	Bench[1]	Simme Seat	Trash Receptacle	Real-Time	System Map	System Schedule
Millbrae	16	100%	25%	75%	0%	94%	0%	19%	0%
Pacifica	87	94%	11%	2%	0%	16%	0%	11%	1%
Palo Alto	25	84%	32%	32%	0%	48%	0%	0%	0%
Portola Valley	*No standard routes (school-oriented routes only)*								
Redwood City	110	96%	13%	32%	0%	31%	0%	6%	0%
San Bruno	70	100%	11%	31%	0%	20%	0%	6%	9%
San Carlos	38	87%	21%	34%	0%	29%	0%	8%	0%
San Francisco	53	87%	42%	4%	0%	19%	0%	2%	0%
San Mateo	138	98%	18%	22%	1%	35%	0%	4%	1%
South San Francisco	114	92%	20%	19%	5%	38%	0%	11%	0%
Woodside	2	50%	0%	0%	0%	0%	0%	0%	0%
Unincorporated San Mateo County	107	90%	10%	7%	0%	7%	0%	1%	0%
Systemwide	**1,238**	**94%**	**18%**	**19%**	**1%**	**28%**	**0%**	**8%**	**1%**

Note: The shelter type and number of benches, simme seats, and trash receptacles were simplified for this table to just show if a stop includes at least one of the defined amenities. Quantity of amenities was also collected and is available for review on the Dashboard.
1. To avoid double-counting seating included as a part of shelters, this category includes only stops with standalone benches separate from the shelter-provided seating.
Source: Fehr & Peers, 2022.

Bus Stops Serving School-Oriented Routes

Aside from the presence of a bus stop sign and pole, bus stops serving school-oriented routes generally have fewer amenities than bus stops served by standard routes. Systemwide, only 8 percent have shelters and 13 percent have trash receptacles. This is expected, as school-oriented routes only have a few runs a day, so amenities will be utilized less often than at stops serving standard routes. Table 4 indicates the percentage of stops with the quantified amenity by jurisdiction for stops served by school-oriented routes.

Table 4: School-Oriented Routes Rider Amenities Summary

Jurisdiction	Total # of Stops	Pole & Sign	Shelter	Bench[1]	Simme Seat	Trash Receptacle	Real-Time	System Map	System Schedule
Atherton	13	92%	0%	8%	0%	8%	0%	0%	0%
Belmont	60	93%	5%	12%	0%	10%	0%	2%	0%
Brisbane	16	100%	50%	6%	0%	56%	0%	25%	0%
Burlingame	14	86%	0%	7%	0%	7%	0%	0%	0%
Colma	*No school-oriented routes (standard routes only)*								
Daly City	159	96%	13%	6%	0%	13%	0%	8%	0%

Jurisdiction	Total # of Stops	Pole & Sign	Shelter	Bench[1]	Simme Seat	Trash Receptacle	Real-Time	System Map	System Schedule
East Palo Alto	43	93%	9%	12%	0%	21%	0%	2%	0%
Foster City	70	96%	7%	3%	1%	7%	0%	6%	0%
Half Moon Bay	31	94%	10%	6%	0%	16%	0%	0%	0%
Menlo Park	101	94%	9%	16%	0%	14%	0%	9%	0%
Millbrae	*No school-oriented routes (standard routes only)*								
Pacifica	114	94%	10%	2%	0%	13%	0%	9%	1%
Palo Alto	*No school-oriented routes (standard routes only)*								
Portola Valley	17	94%	0%	0%	0%	0%	0%	0%	0%
Redwood City	77	99%	8%	18%	0%	14%	0%	5%	0%
San Bruno	68	100%	1%	24%	0%	7%	0%	0%	3%
San Carlos	42	90%	12%	7%	0%	5%	0%	2%	0%
San Francisco	2	100%	0%	0%	0%	0%	0%	0%	0%
San Mateo	101	97%	8%	13%	0%	16%	0%	1%	1%
South San Francisco	92	95%	10%	15%	7%	26%	0%	4%	0%
Woodside	9	100%	0%	0%	0%	0%	0%	0%	0%
Unincorporated San Mateo County	103	99%	1%	5%	0%	1%	0%	1%	0%
Systemwide	**1,132**	**96%**	**8%**	**10%**	**1%**	**13%**	**0%**	**5%**	**0%**

Note: The shelter type and number of benches, simme seats, and trash receptacles were simplified for this table to just show if a stop includes at least one of the defined amenities. Quantity of amenities was also collected and is available for review on the Dashboard.
1. To avoid double-counting seating included as a part of shelters, this category includes only stops with standalone benches separate from the shelter-provided seating.
Source: Fehr & Peers, 2022.

Typical Conditions

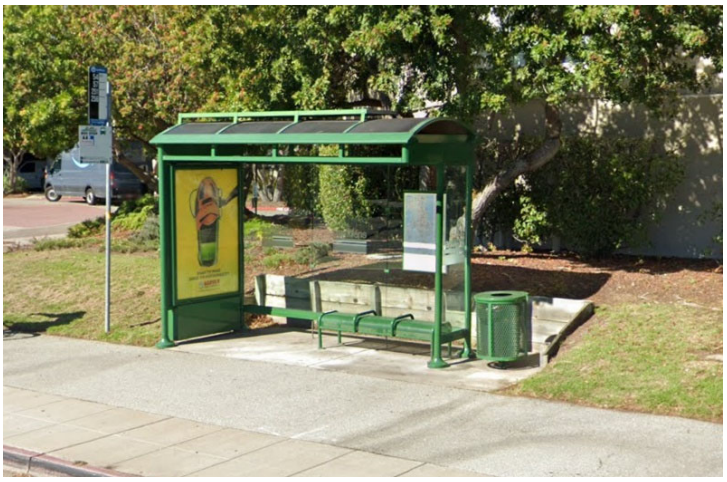
The following examples show a variety of current trends in amenities across the SamTrans system across a variety of stop types and common scenarios.

This stop at El Camino Real (ECR) and Belmont Avenue in San Carlos shows typical conditions along El Camino Real. The ECR is the busiest route in the system, and most stops have at minimum a sign, bench, and trash receptacle, with shelters present at some stops.

The Redwood City Transit Center shows typical conditions at transit hubs. Most transit centers include ample shelters, benches, trash receptacles, and wayfinding information.

Typical of many routes across the network, this stop on Arroyo Drive in Daly City is located on a residential street. This is the most common type of stop across the system. Usually only a bus stop sign is provided, and there is limited space for passengers to wait for the bus.

As the SamTrans service area includes communities along the coast and in the hills, the agency has several more rural stops, like this one on Portola Road in Portola Valley. These stops generally have a bus stop sign and may lack sidewalks, lighting, or visibility.



With signage, wayfinding, shelter, seating, and a trash receptacle, the bus stop at Hillsdale Blvd. and Edgewater Blvd. in Foster City represents a complete stop, with all baseline amenities currently provided present.

Numerous stops in North San Mateo County serving standard routes have high ridership relative to the rest of the system, like this one on Southgate Avenue in Daly City, yet lack amenities beyond a bus stop sign.

Adoption of Simme seats across the network remains limited, with only 11 stops total. Half of these, including the stop to the left at Grand Avenue and Willow Avenue, are in South San Francisco.

Pedestrian and Bicycle Access to Bus Stops

Almost all transit users are pedestrians at some point along their journey. Providing comfortable connections for people walking and rolling to bus stops can improve the overall rider experience and increase the number of origins and destinations accessible by the overall transit network. Factors that affect walkable connections include the presence and width of sidewalks and curb ramps, presence and control type of crosswalks, and presence and type of bike facilities.

Overall, 91 percent of bus stops at standard routes include a sidewalk connection, 74 percent include access to a curb ramp, 65 percent include access to a marked or signalized crosswalk, and 36 percent include each of these pedestrian elements. School-oriented routes mirror these trends, though slightly lower proportions include each element. Table 5 and Table 6 show a summary of these multimodal factors for both standard and school-oriented routes.

Table 5: Standard Routes Bicycle and Pedestrian Amenities by Jurisdiction Summary

Jurisdiction	Total # of Stops	Sidewalk	Curb Ramps[1]	Crosswalk[1]	Signalized Crosswalk[2]	All Treatments	Bike Facility Nearby[3]
Atherton	12	0%	58%	50%	42%	0%	50%
Belmont	33	91%	70%	64%	42%	39%	42%
Brisbane	12	67%	75%	83%	83%	67%	100%
Burlingame	46	93%	83%	72%	65%	57%	41%
Colma	11	91%	73%	73%	73%	64%	27%
Daly City	198	99%	82%	63%	27%	27%	69%
East Palo Alto	53	92%	68%	60%	25%	23%	38%
Foster City	26	100%	92%	54%	42%	42%	92%
Half Moon Bay	37	54%	35%	32%	16%	11%	22%
Menlo Park	50	98%	70%	56%	26%	24%	50%
Millbrae	16	100%	94%	88%	88%	81%	69%
Pacifica	87	92%	57%	63%	13%	10%	22%
Palo Alto	25	100%	92%	68%	60%	60%	*Data not available*
Portola Valley	*No standard routes (school-oriented routes only)*						
Redwood City	110	95%	73%	70%	46%	43%	65%
San Bruno	70	99%	79%	80%	44%	44%	17%
San Carlos	38	92%	61%	45%	37%	32%	55%
San Francisco	53	94%	77%	79%	74%	57%	*Data not available*
San Mateo	138	100%	85%	79%	54%	53%	60%
South San Francisco	114	98%	96%	77%	47%	44%	61%

Jurisdiction	Total # of Stops	Sidewalk	Curb Ramps[1]	Crosswalk[1]	Signalized Crosswalk[2]	All Treatments	Bike Facility Nearby[3]
Woodside	2	50%	50%	50%	50%	50%	50%
Unincorporated San Mateo County	107	63%	49%	35%	26%	19%	35%
Systemwide	**1,238**	**91%**	**74%**	**65%**	**40%**	**36%**	**48%**

Notes:
1. Determined for the nearest intersection. A bus stop was determined to have curb ramps and crosswalks if a pedestrian, regardless of direction of travel, could reach the bus stop via a crosswalk and curb cut.
2. Signalized crosswalks include locations with a full signal or Pedestrian Hybrid Beacon.
3. Bike facility information only available for jurisdictions in San Mateo County.

Source: Fehr & Peers, 2022.

Table 6: School-Oriented Routes Bicycle and Ped. Amenities by Jurisdiction Summary

Jurisdiction	Total # of Stops	Sidewalk	Curb Ramps[1]	Crosswalk[1]	Signalized Crosswalk[2]	All Treatments	Bike Facility Nearby[3]
Atherton	13	38%	31%	23%	15%	0%	69%
Belmont	60	83%	52%	42%	23%	20%	48%
Brisbane	16	75%	81%	81%	69%	56%	69%
Burlingame	14	100%	86%	71%	29%	29%	79%
Colma	*No school-oriented routes (standard routes only)*						
Daly City	159	97%	79%	64%	26%	25%	70%
East Palo Alto	43	84%	49%	47%	26%	23%	37%
Foster City	70	100%	86%	59%	24%	24%	81%
Half Moon Bay	31	52%	32%	29%	13%	10%	23%
Menlo Park	101	92%	68%	48%	11%	9%	53%
Millbrae	*No school-oriented routes (standard routes only)*						
Pacifica	114	94%	53%	59%	11%	9%	21%
Palo Alto	*No school-oriented routes (standard routes only)*						
Portola Valley	17	24%	6%	35%	0%	0%	6%
Redwood City	77	96%	73%	64%	25%	25%	66%
San Bruno	68	99%	72%	69%	21%	21%	16%
San Carlos	42	98%	50%	48%	19%	19%	55%
San Francisco	2	100%	50%	50%	50%	50%	*Data not available*
San Mateo	101	93%	70%	65%	35%	35%	63%
South San Francisco	92	99%	82%	68%	24%	23%	58%
Woodside	9	11%	11%	11%	0%	0%	56%

Jurisdiction	Total # of Stops	Sidewalk	Curb Ramps[1]	Crosswalk[1]	Signalized Crosswalk[2]	All Treatments	Bike Facility Nearby[3]
Unincorporated San Mateo County	103	59%	40%	26%	12%	9%	31%
Systemwide	**1,132**	**88%**	**64%**	**55%**	**21%**	**20%**	**50%**

Notes:

1. Determined for the nearest intersection. A bus stop was determined to have curb ramps and crosswalks if a pedestrian, regardless of direction of travel, could reach the bus stop via a crosswalk and curb cut.
2. Signalized crosswalks include locations with a full signal or Pedestrian Hybrid Beacon.
3. Bike facility information only available for jurisdictions in San Mateo County.

Source: Fehr & Peers, 2022.

Operational Factors

The design and placement of on-street bus stops can have an effect on bus operational efficiencies. In most urban and suburban contexts, bus stops should be located in lane and on the far side of an intersection in order to limit conflicts with other vehicles and pedestrians while limiting bus delays at stops. Red curb and parking restrictions help ensure bus access to the curb and preserve equitable access for riders who require mobility assistance. Operational factors inventoried include:

- **Location:** For bus stops located on-street, there are generally two configurations - "in lane" or "pull-out" stops. In-lane stops allow for the bus to stop in the travel lane, instead of pulling into the parking lane and back out into the travel lane. In-lane stops minimize dwell times at bus stops and speed up service.
- **Position:** Bus stops are generally positioned either at the near-side of the intersection, far-side of the intersection, or mid-block. Far-side stops are preferred as they allow for the bus to clear the intersections before stopping to load passengers, avoiding conflicts with right-turning vehicles and sight line obstructions of pedestrians.
- **Bus pads:** Bus pads refer to a section of concrete added to the street immediately adjacent to the bus stop to minimize damage to the road from repeated bus movements. As wear and tear on pavement is correlated with vehicle weight and concrete is more durable than asphalt, adding bus pads can improvement pavement longevity.
- **Red curb and on-street parking:** On-street parking restrictions around bus stops reduce dwell time for riders with limited mobility, especially those customers using mobility devices such as wheelchairs who require the bus ramp to be extended. Adding a section of red curb to a parking restriction at the bus stop can improve visibility and compliance.
- **Bus stop length:** The length of a bus stop impacts the maneuverability of transit vehicles pulling into and out of the curb. Currently, the *Bus Stop Guidebook* (SamTrans, 2013) has a minimum desired bus stop length of 75 feet, which can vary depending on specific design contexts.

Bus Stops Serving Standard Routes

The feasibility of implementing these best practices may vary by stop depending on considerations such as roadway geometry, sight lines, and jurisdictional priorities. Systemwide, a majority of standard route stops are located on the far-side of intersections and have parking restrictions, while 31 percent are the minimum stop length outlined in SamTrans policy. Table 7 indicates the percentage of stops with each operational factor by jurisdiction for standard routes.

Table 7: Standard Routes Operational Factors Summary

Jurisdiction	Total # of Stops	In-Lane	Far-Side	Bus Pads	Have Parking Restriction	Stop Length > 75 Feet
Atherton	12	58%	75%	8%	100%	75%
Belmont	33	45%	36%	30%	88%	48%
Brisbane	12	0%	67%	17%	92%	83%
Burlingame	46	57%	61%	13%	93%	37%
Colma	11	9%	27%	27%	91%	55%
Daly City	198	15%	50%	9%	51%	18%
East Palo Alto	53	28%	58%	2%	58%	21%
Foster City	26	42%	58%	4%	92%	73%
Half Moon Bay	37	14%	43%	3%	86%	43%
Menlo Park	50	52%	46%	14%	88%	38%
Millbrae	16	6%	69%	19%	100%	75%
Pacifica	87	37%	44%	1%	63%	20%
Palo Alto	25	8%	44%	12%	100%	36%
Portola Valley	*No standard routes (school-oriented routes only)*					
Redwood City	110	16%	56%	16%	84%	29%
San Bruno	70	26%	44%	33%	67%	23%
San Carlos	38	16%	61%	45%	74%	42%
San Francisco	53	49%	75%	57%	85%	62%
San Mateo	138	29%	59%	20%	75%	29%
South San Francisco	114	27%	51%	20%	72%	23%
Woodside	2	0%	50%	0%	0%	0%
Unincorporated San Mateo County	107	18%	50%	8%	50%	18%
Systemwide	**1,238**	**26%**	**53%**	**17%**	**71%**	**31%**

Source: Fehr & Peers, 2022.

Bus Stops Serving School-Oriented Routes

While specific results vary across jurisdictions, stops served by school-oriented routes are less likely to have parking restrictions in front of bus stops and thus more likely to encounter parked cars blocking bus stops, since nearly 40 percent of stops serving school-oriented routes are along residential streets. Table 8 indicates the percentage of stops with each operational factor by jurisdiction for school-oriented routes.

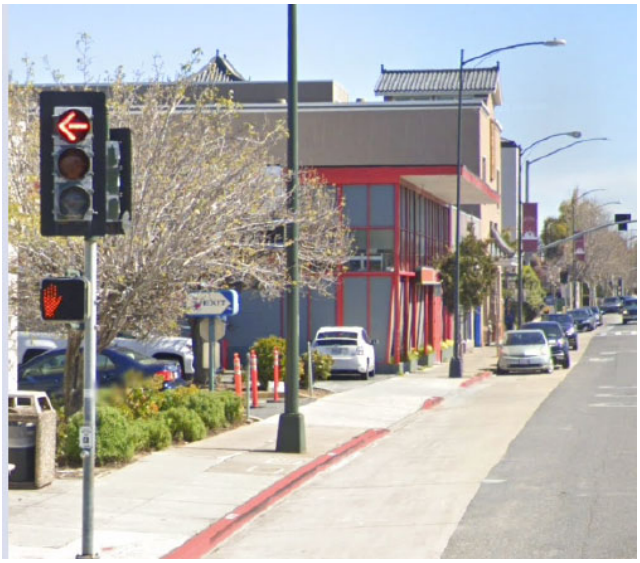
Table 8: School-Oriented Routes Operational Factors Summary

Jurisdiction	Total # of Stops	In-Lane	Far-Side	Bus Pads	Have Parking Restriction	Stop Length > 75 Feet
Atherton	13	62%	38%	8%	100%	46%
Belmont	60	47%	27%	7%	63%	25%
Brisbane	16	19%	56%	6%	94%	75%
Burlingame	14	29%	50%	7%	71%	14%
Colma	*No school-oriented routes (standard routes only)*					
Daly City	159	11%	52%	9%	37%	14%
East Palo Alto	43	28%	44%	2%	53%	16%
Foster City	70	34%	43%	0%	73%	53%
Half Moon Bay	31	10%	42%	3%	81%	45%
Menlo Park	101	50%	42%	3%	82%	26%
Millbrae	*No school-oriented routes (standard routes only)*					
Pacifica	114	35%	40%	1%	59%	18%
Palo Alto	*No school-oriented routes (standard routes only)*					
Portola Valley	17	24%	35%	0%	76%	65%
Redwood City	77	29%	57%	6%	73%	14%
San Bruno	68	24%	43%	6%	37%	12%
San Carlos	42	17%	40%	12%	45%	14%
San Francisco	2	50%	50%	0%	50%	0%
San Mateo	101	23%	53%	7%	65%	16%
South San Francisco	92	15%	42%	12%	53%	16%
Woodside	9	78%	33%	0%	89%	0%
Unincorporated San Mateo County	103	23%	42%	0%	48%	15%
Systemwide	**1,132**	**27%**	**45%**	**5%**	**59%**	**22%**

Source: Fehr & Peers, 2022.

Typical Conditions

The following examples show a variety of current trends in operational characteristics across the SamTrans system across a variety of stop types and common scenarios.



Common along El Camino Real and other major arterials, this stop at El Camino Real and Hillcrest Boulevard in Millbrae shows illustrates a typical pull-out stop where buses often encounter delay merging back into traffic.

Bus bulbs, like this one at Mission and Goethe in Daly City, allow buses to stop in-lane. This treatment eliminates delays that buses encounter merging into traffic. Bus bulbs can also enable space for bus shelters and shorten pedestrian crossing distances.

This stop at Magnolia and Trousdale in Burlingame is an example of a near-side stop. With this configuration, the stopped bus can block sight lines between pedestrians crossing the street and other vehicles, while also encountering conflicts with right-turning vehicles.

More typical on larger volume streets such as El Camino Real and areas with many signalized intersections, far-side stops like the one seen here in South San Francisco allow the bus to clear the intersection before serving riders, limiting the signal delay and improving bus speeds.

Many SamTrans stops across the network have on-street parking restrictions, clearly delineated by a red curb, such as this example on Whipple Avenue in Redwood City. This allows easy access to the stop for buses and passengers. However, not all stops are properly sized for buses, as illustrated in this example.

Some SamTrans stops allow parking to overlap the bus stop. For instance, this example in South San Francisco only prohibits parking on certain days for street sweeping. Vehicles blocking the stop can make it difficult for mobility-impaired passengers to access the bus.

Contextual Factors

This section summarizes the contextual surroundings of SamTrans bus stops across the service area. Considerations such as urban heat islands, equity, and density of activity around a stop affects the type of amenities that may be needed. While this section summarizes key takeaways, the Dashboard provides the ability to filter bus stops by these contextual factors.

This report summarizes key takeaways from this analysis. Further exploration of contextual factors can be done in the Dashboard. Table 2 summarizes all contextual factors and associated data sources considered.

Bus Stops within High Heat Index Areas

In the 2021 *SamTrans Adaptation and Resilience Plan*, SamTrans defined "Heat Index Areas" to understand the spectrum of vulnerability to the impacts of climate change, based on a series of environmental, demographic, and socioeconomic factors, across the system. During increasingly prevalent high heat events, a lack of shade and place to sit can be stressful for riders waiting for long periods of time.

Approximately 207 stops, or 11 percent of all SamTrans stops, are located in high heat index areas. San Mateo, South San Francisco, and East Palo Alto are jurisdictions with the highest proportion of stops in these areas; the full jurisdictional breakdown can be seen below. Just 46 percent, or 95 stops, of these stops have a place to sit, and only 25 percent, or 52 stops, have a shelter to provide shade.

Table 9: High Heat Index Areas Stop Summary

Jurisdiction	Total Stops	High Heat Stops (#)	High Heat Stops (%)
East Palo Alto	68	41	60%
Redwood City	180	32	18%
San Bruno	105	13	12%
San Carlos	64	9	14%
San Francisco	58	20	34%
San Mateo	191	47	23%
South San Francisco	180	45	25%
Systemwide	**1,871**	**207**	**11%**

Note: all other jurisdictions have 0 stops in high heat index areas. Source: Fehr & Peers, 2022.

Bus Stops within Equity Priority Areas

SamTrans has defined "Equity Priority Areas" based on three factors that typically illustrate the greatest transit needs and inequalities within its service area:

- Zero-car households

- Lower-income households, defined by households earning less than $75,000 per year
- Non-white households, households with persons identifying as a race or ethnicity other than white

Most bus stops within the SamTrans network serve riders that may be characterized as equity priority populations, so nearly every bus stop serves a role in advancing more equitable transportation outcomes. However, identifying improvements to operations and rider amenities at stops in Equity Priority Areas can further the goal of Reimagine SamTrans to improve the transit experience in these communities. Overall, 822 bus stops, or nearly 44 percent of all stops, are located within Equity Priority Areas. The jurisdictions with the highest proportion of stops in Equity Priority Areas are East Palo Alto, Daly City, Millbrae, and South San Francisco, with a full jurisdictional breakdown available in Table 10.

Table 10: Equity Priority Areas Stop Summary

Jurisdiction	Total Stops	Equity Priority Area Stops (#)	Equity Priority Area Stops (%)
Belmont	74	40	54%
Brisbane	17	9	53%
Burlingame	56	19	34%
Colma	11	1	9%
Daly City	242	210	87%
East Palo Alto	68	64	94%
Foster City	81	26	32%
Half Moon Bay	39	17	44%
Menlo Park	120	27	23%
Millbrae	16	13	81%
Pacifica	117	3	3%
Palo Alto	27	2	7%
Redwood City	180	76	42%
San Bruno	105	45	43%
San Francisco	58	3	5%
San Mateo	191	79	41%
South San Francisco	180	134	74%
Unincorporated San Mateo County	173	54	31%
Systemwide	**1,871**	**822**	**44%**

Note: all other jurisdictions have zero stops in Equity Priority Areas.
Source: Fehr & Peers, 2022.

Bus Stops within High Activity Density Areas

Activity density is defined as census tracts with higher population and job densities. The service area was then broken into five buckets from low to high activity density based on natural breaks in the data. High activity density areas can provide another measure of transit propensity, since ridership demand often correlates with large number of trip generators, walkability, parking constraints, and other built environment factors.

About 191 stops, or about 10 percent of the total number of stops, are in areas with medium-high and high activity densities. These stops are primarily concentrated in a few cities: Daly City, South San Francisco, San Francisco, Redwood City, San Mateo, and East Palo Alto. The jurisdictional breakdown of high activity density areas is presented in the table below.

Table 11: Medium-High and High Activity Density Areas Stop Summary

Jurisdiction	Total Stops	Medium-High to High Activity Stops (#)	Medium-High to High Activity Stops (#)
Burlingame	56	5	9%
Daly City	242	79	33%
East Palo Alto	68	13	19%
Foster City	81	2	2%
Redwood City	180	18	10%
San Bruno	105	5	5%
San Carlos	64	9	14%
San Francisco	58	20	34%
San Mateo	191	15	8%
South San Francisco	180	23	13%
Unincorporated San Mateo County	173	1	1%
Systemwide	**1,871**	**191**	**10%**

Note: All other jurisdictions have 0 stops in medium-high to high activity density areas.
Source: Fehr & Peers, 2022.

High Ridership Stops

Measuring amenity and contextual information surrounding SamTrans stops with the highest ridership is one important way to visualize how investments can reach the largest number of SamTrans riders. The following information is provided for the top 10 percent of stops inventoried by average daily ridership in September 2022. These 188 stops see an average of 180 riders per day (boardings and alightings), compared to 31 riders for all stops across the system.

- **Amenities:** 46 percent of these high-ridership stops have some sort of shelter, while 31 percent have standalone benches or simme seats. 26 percent of these stops lack both shade and a place to sit, with the highest concentrations in Daly City and San Mateo.
- **Pedestrian access:** 98 percent of high ridership stops have access to a sidewalk and 83 percent of these stops have curb cuts at the nearest intersection. 80 percent of stops have crosswalks at the nearest intersection.
- **Operational factors:** 89 percent of stops have no on street parking allowed, with 59 percent of stops having parking restrictions indicated by a red curb. However, only 38 percent of stops met the minimum desired length of 75 feet.

Brisbane, Foster City, Portola Valley, and Woodside do not have any stops within the top 10th percentile of ridership. Table 12 below shows a full breakdown of high ridership stops across other jurisdictions.

Table 12: High Ridership Stops Summary

Jurisdiction	Total # of Stops	High Ridership Stops (#)	High Ridership Stops (%)
Atherton	24	1	4%
Belmont	74	6	8%
Burlingame	56	9	16%
Colma	11	1	9%
Daly City	242	52	21%
East Palo Alto	68	3	4%
Half Moon Bay	39	2	5%
Menlo Park	120	4	3%
Millbrae	16	9	56%
Pacifica	117	3	3%
Palo Alto	27	5	19%
Redwood City	180	14	8%
San Bruno	105	13	12%
San Carlos	64	8	13%
San Francisco	58	7	12%
San Mateo	191	30	16%
South San Francisco	180	20	11%

Jurisdiction	Total # of Stops	High Ridership Stops (#)	High Ridership Stops (%)
Unincorporated San Mateo County	173	1	1%
Systemwide	**1,871**	**188**	**10%**

Source: Fehr & Peers, 2022.

Jurisdiction Cutsheets

The following section provides a visual summary of some of the primary attributes of the bus stop inventory for each jurisdiction across the SamTrans service area. In addition to a map showing the location of SamTrans stops across the jurisdiction, each cutsheet includes summary information regarding:

- The total and average daily ridership (boarding and alightings)
- The percentage of stops with a bench or place to sit
- The percentage of stops with a shelter provided
- The percentage of stops with sidewalk access and a crosswalk and curb cuts at the nearest intersection
- The percentage of stops that are far-side stops
- The percentage of stops with on-street parking restrictions

As with the summary information presented in the report above, further visuals can be explored within the Dashboard.

Jurisdiction

GEOGRAPHY

TOTAL BUS STOPS as of 8/7/2022

TOTAL DAILY ONS+OFFS in SEPTEMEBER 2022

AVERAGE DAILY RIDERSHIP PER STOP

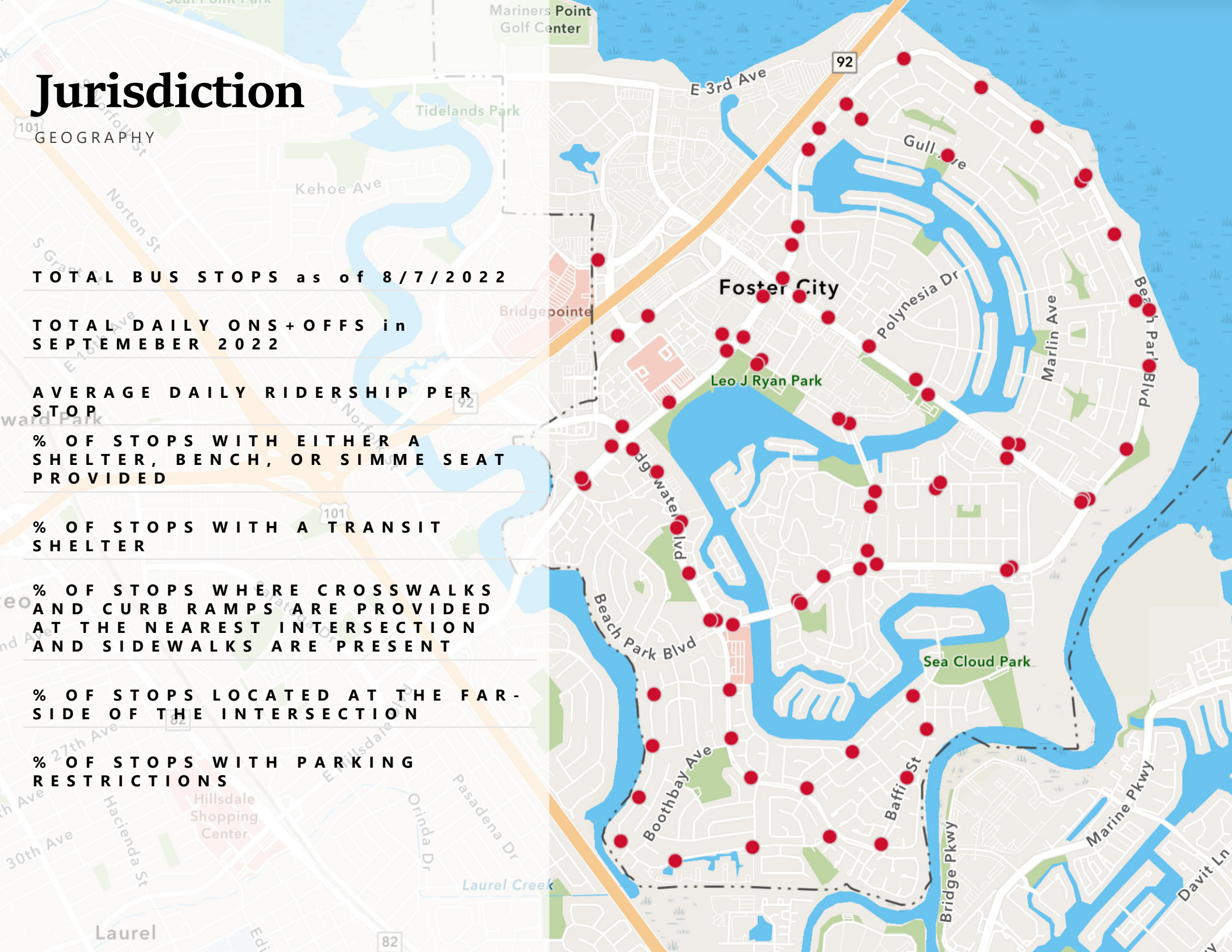
% OF STOPS WITH EITHER A SHELTER, BENCH, OR SIMME SEAT PROVIDED

% OF STOPS WITH A TRANSIT SHELTER

% OF STOPS WHERE CROSSWALKS AND CURB RAMPS ARE PROVIDED AT THE NEAREST INTERSECTION AND SIDEWALKS ARE PRESENT

% OF STOPS LOCATED AT THE FAR-SIDE OF THE INTERSECTION

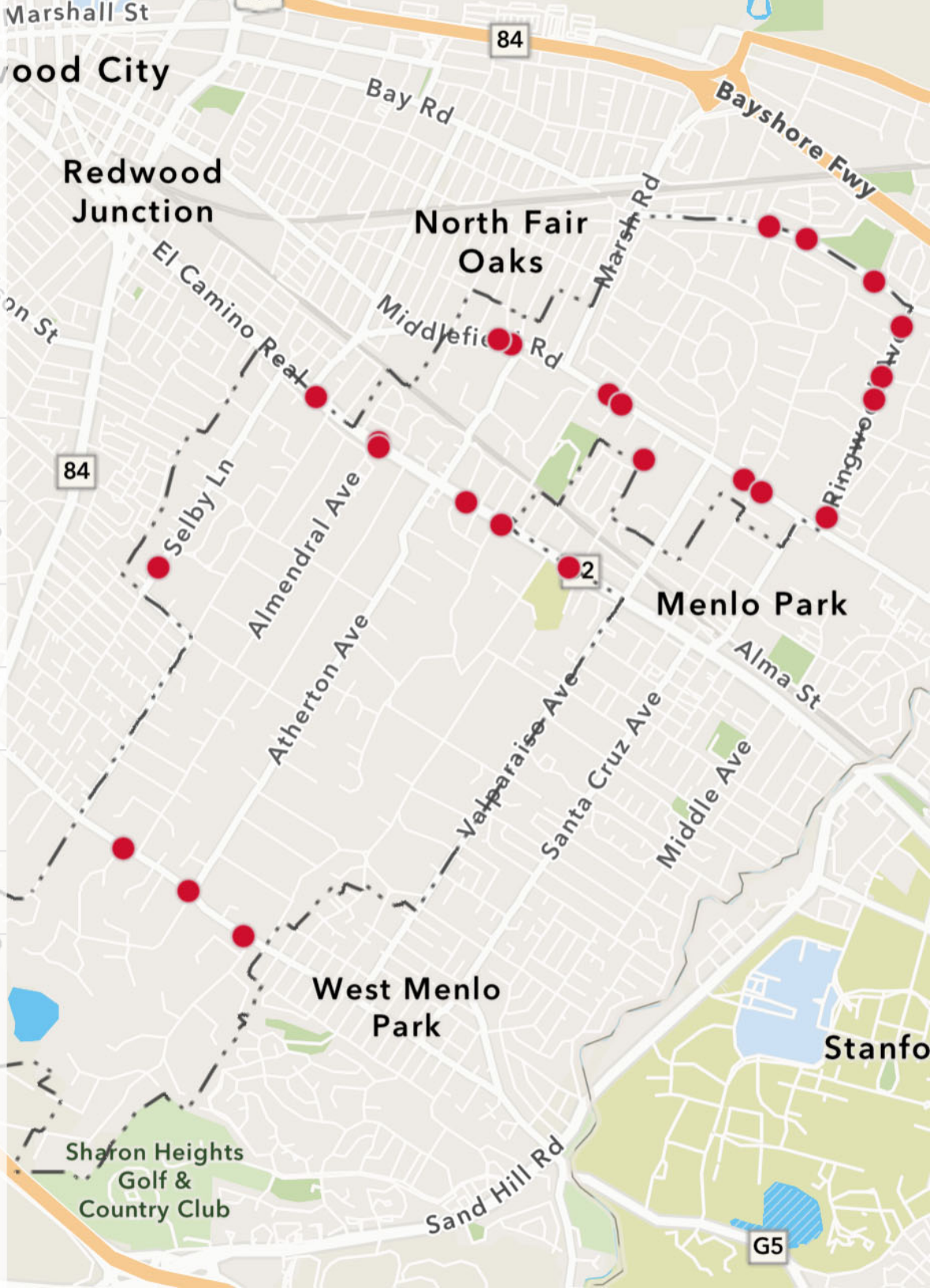
% OF STOPS WITH PARKING RESTRICTIONS



Atherton

SOUTH COUNTY

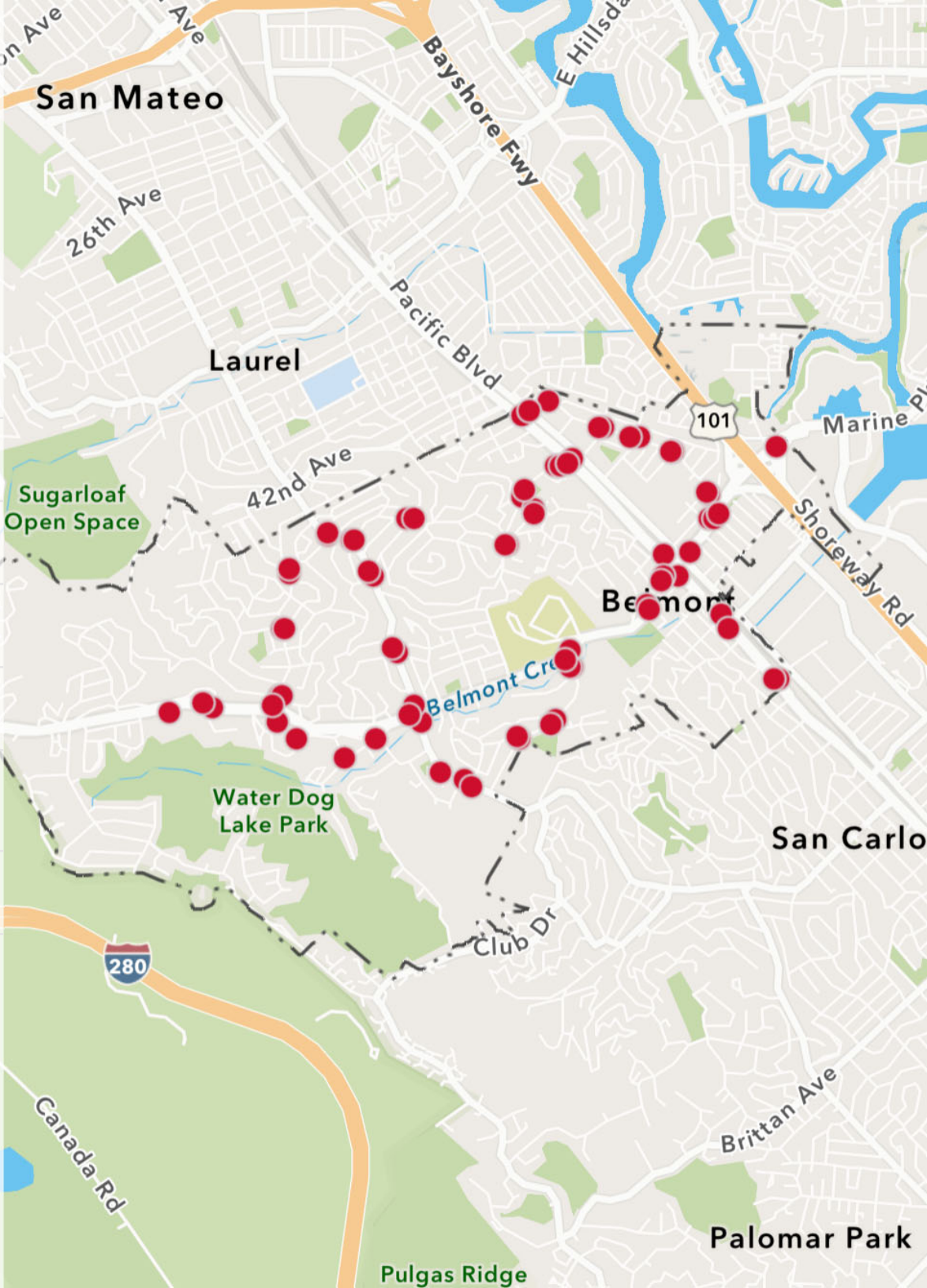
24	TOTAL BUS STOPS
453	TOTAL DAILY RIDERSHIP
19	AVG. DAILY RIDERSHIP
17%	HAVE A PLACE TO SIT
4%	PROVIDE A SHELTER
0%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
54%	ARE FAR-SIDE STOPS
100%	HAVE PARKING RESTRICTIONS



Belmont

MID COUNTY

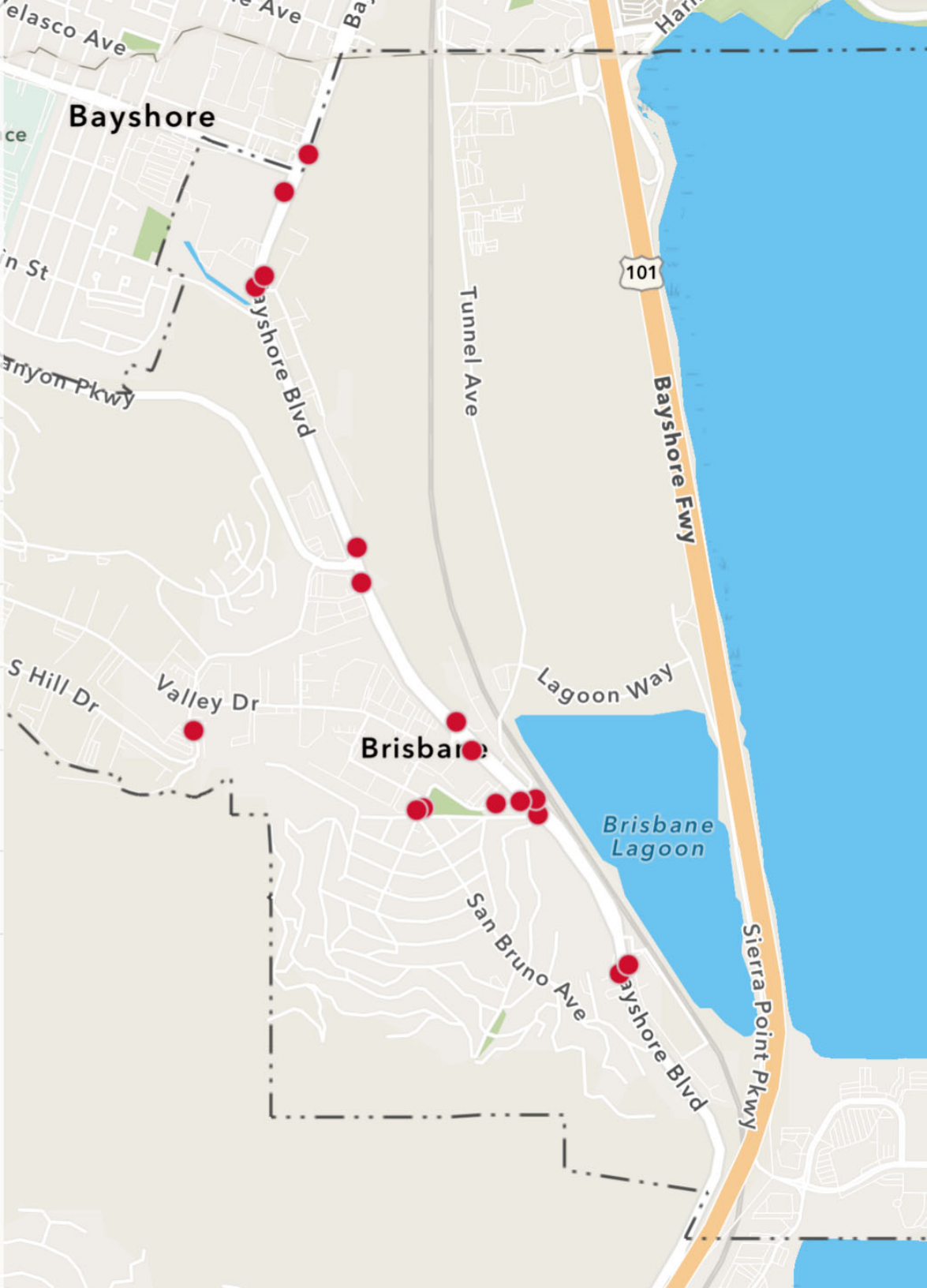
74	TOTAL BUS STOPS
2,150	TOTAL DAILY RIDERSHIP
29	AVG. DAILY RIDERSHIP
23%	HAVE A PLACE TO SIT
8%	PROVIDE A SHELTER
39%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
28%	ARE FAR-SIDE STOPS
69%	HAVE PARKING RESTRICTIONS



Brisbane

NORTH COUNTY

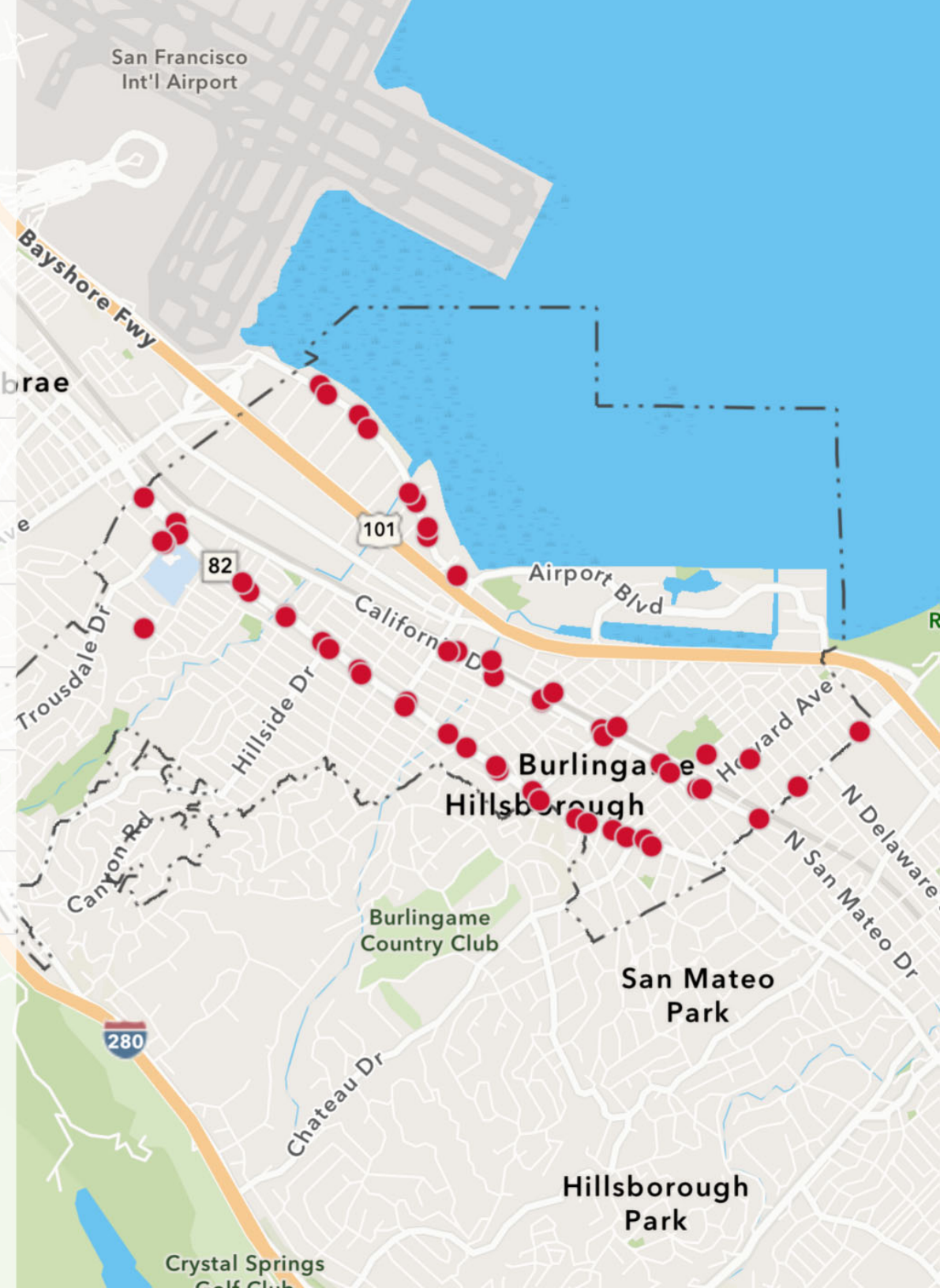
17	TOTAL BUS STOPS
378	TOTAL DAILY RIDERSHIP
22	AVG. DAILY RIDERSHIP
59%	HAVE A PLACE TO SIT
47%	PROVIDE A SHELTER
71%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
59%	ARE FAR-SIDE STOPS
94%	HAVE PARKING RESTRICTIONS



Burlingame

NORTH COUNTY

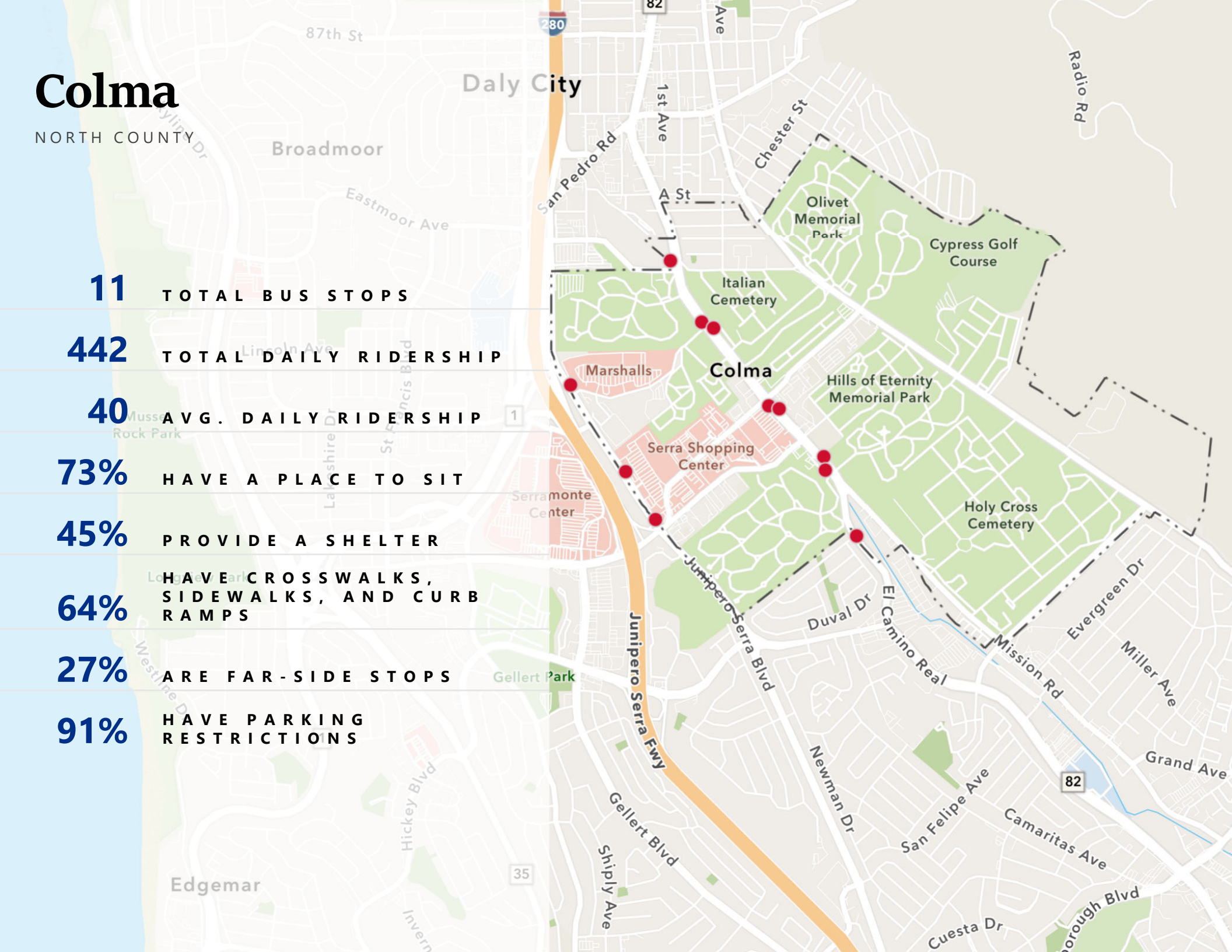
56	TOTAL BUS STOPS
2,008	TOTAL DAILY RIDERSHIP
36	AVG. DAILY RIDERSHIP
66%	HAVE A PLACE TO SIT
25%	PROVIDE A SHELTER
68%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
61%	ARE FAR-SIDE STOPS
95%	HAVE PARKING RESTRICTIONS



Colma

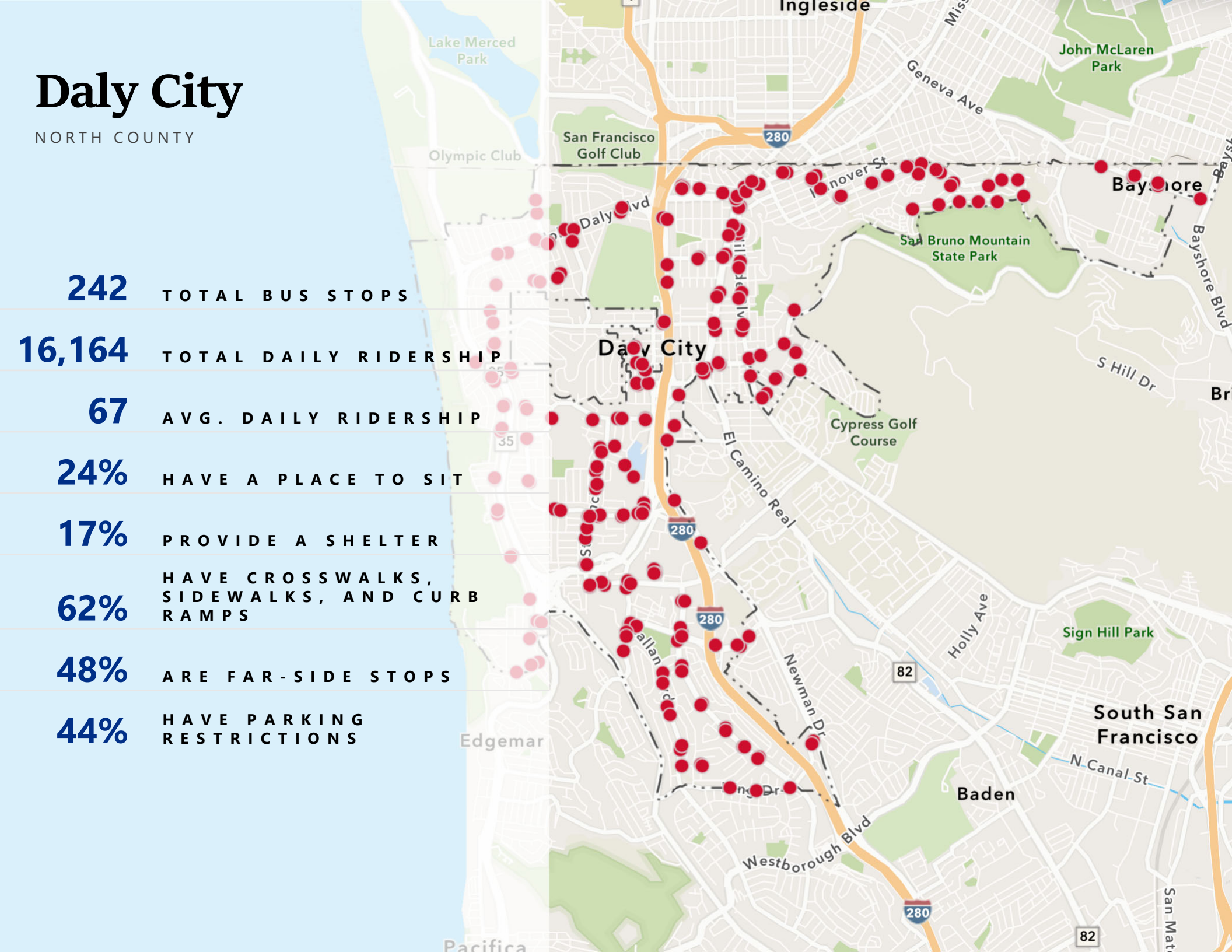
NORTH COUNTY

11	TOTAL BUS STOPS
442	TOTAL DAILY RIDERSHIP
40	AVG. DAILY RIDERSHIP
73%	HAVE A PLACE TO SIT
45%	PROVIDE A SHELTER
64%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
27%	ARE FAR-SIDE STOPS
91%	HAVE PARKING RESTRICTIONS



Daly City

NORTH COUNTY

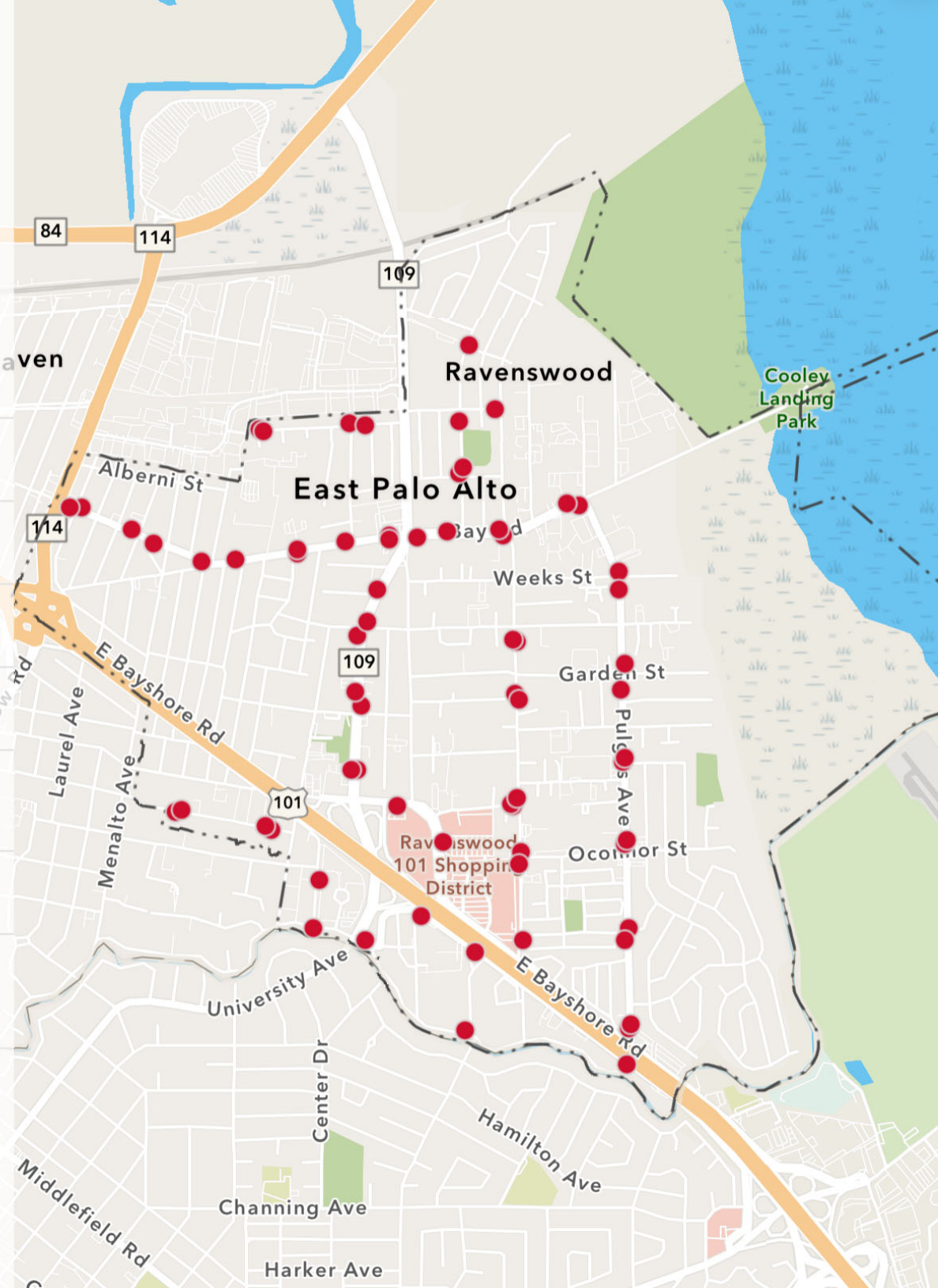


242	TOTAL BUS STOPS
16,164	TOTAL DAILY RIDERSHIP
67	AVG. DAILY RIDERSHIP
24%	HAVE A PLACE TO SIT
17%	PROVIDE A SHELTER
62%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
48%	ARE FAR-SIDE STOPS
44%	HAVE PARKING RESTRICTIONS

East Palo Alto

SOUTH COUNTY

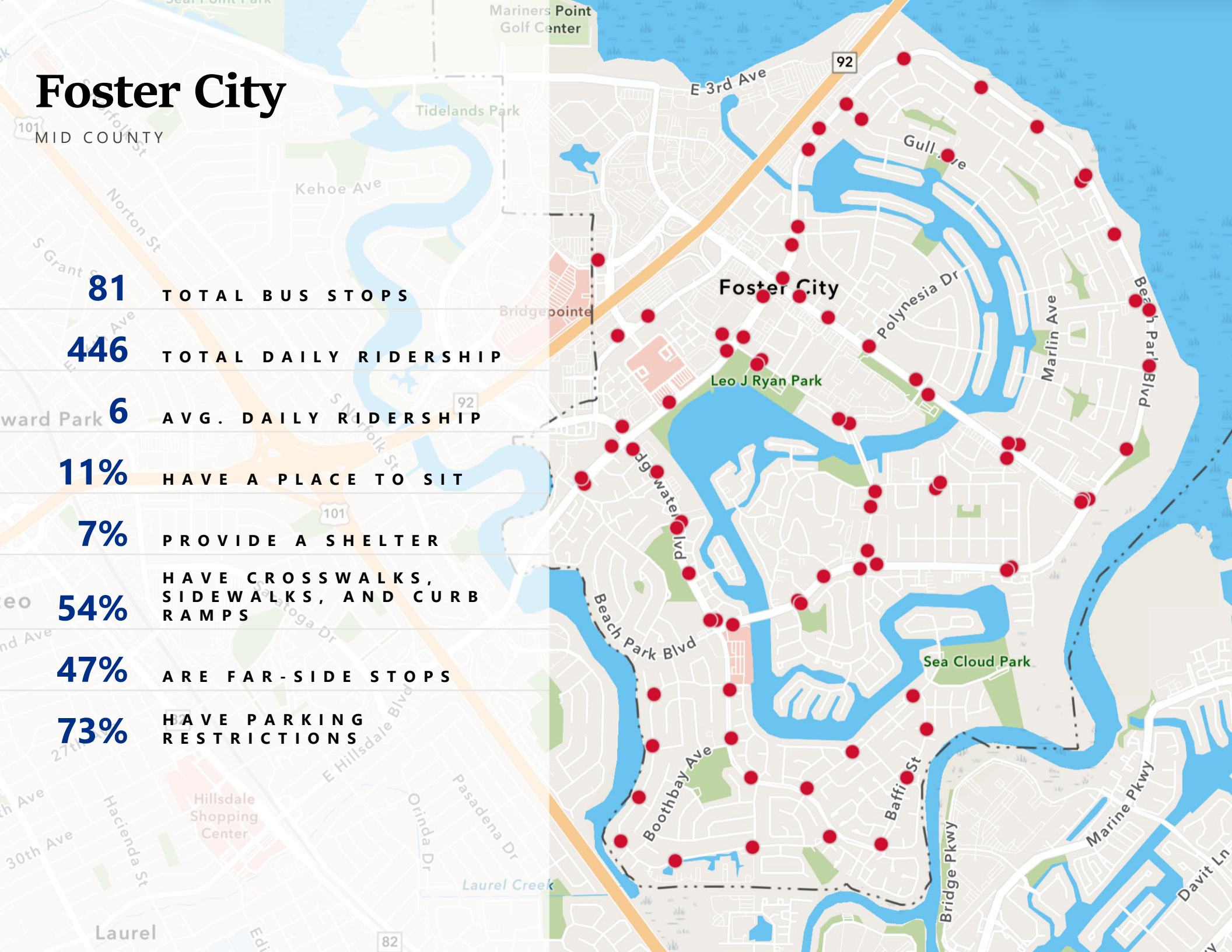
68	TOTAL BUS STOPS
1,558	TOTAL DAILY RIDERSHIP
23	AVG. DAILY RIDERSHIP
28%	HAVE A PLACE TO SIT
15%	PROVIDE A SHELTER
49%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
49%	ARE FAR-SIDE STOPS
54%	HAVE PARKING RESTRICTIONS



Foster City

MID COUNTY

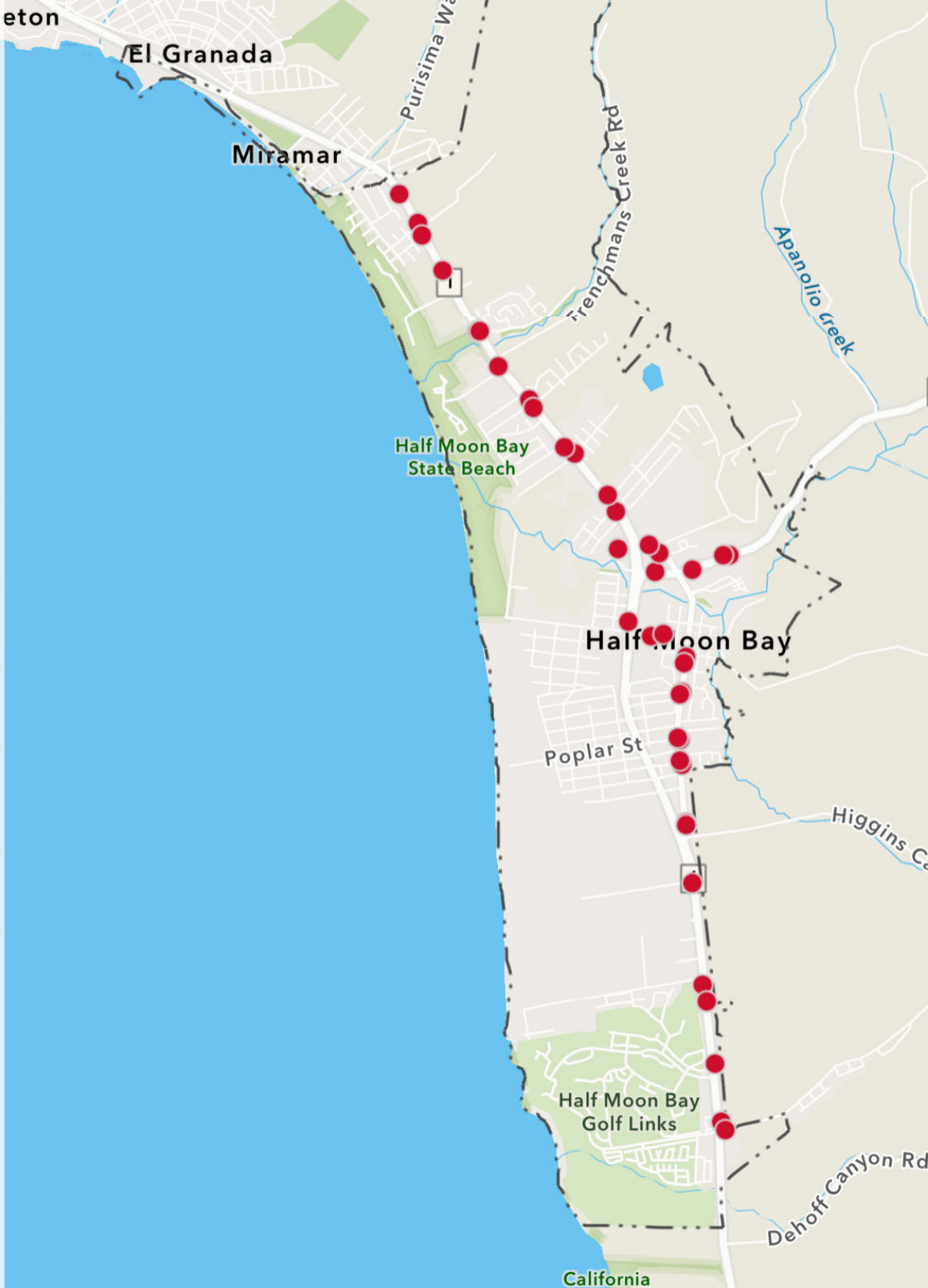
81	TOTAL BUS STOPS
446	TOTAL DAILY RIDERSHIP
6	AVG. DAILY RIDERSHIP
11%	HAVE A PLACE TO SIT
7%	PROVIDE A SHELTER
54%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
47%	ARE FAR-SIDE STOPS
73%	HAVE PARKING RESTRICTIONS



Half Moon Bay

COASTSIDE

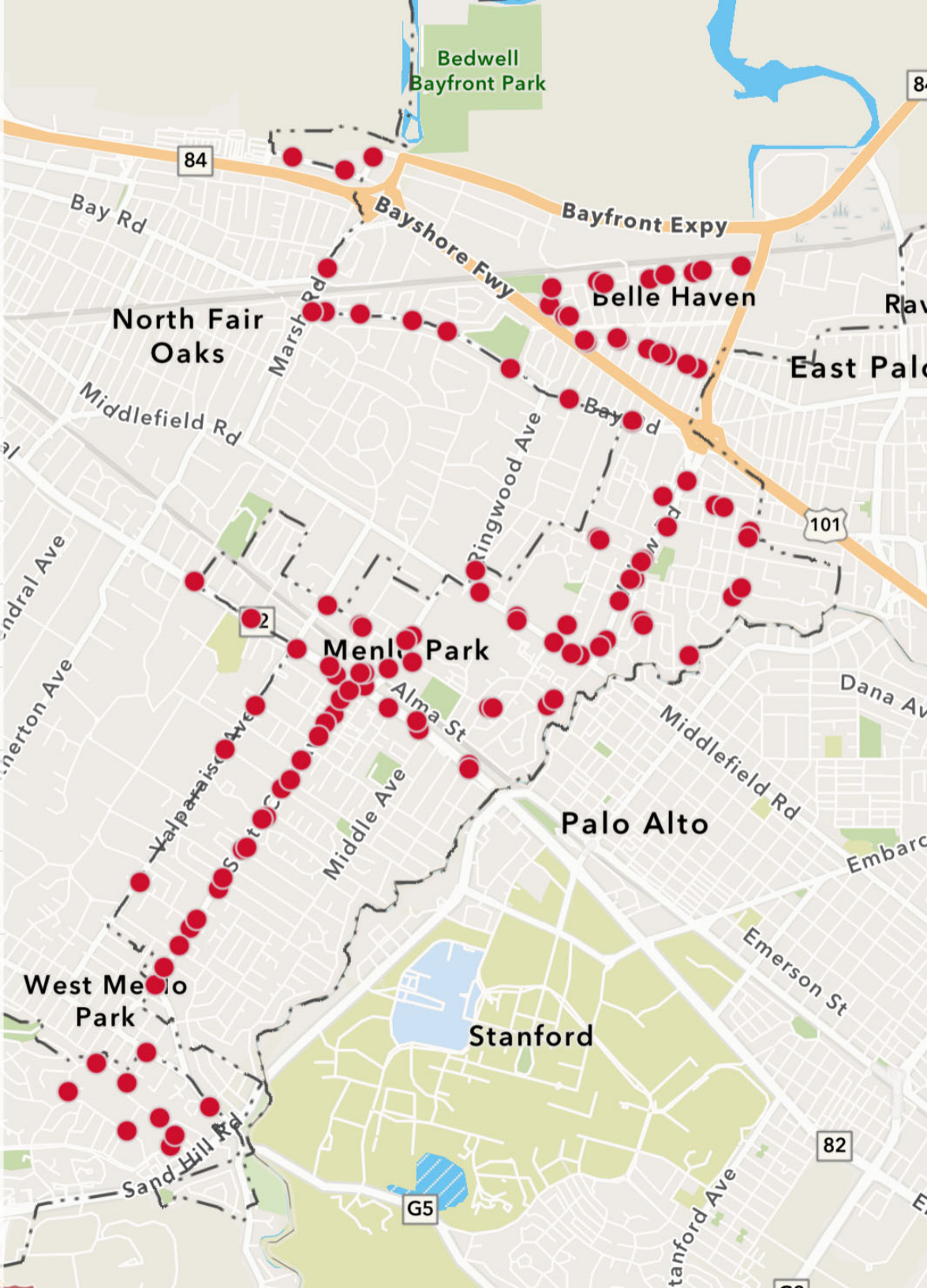
39	TOTAL BUS STOPS
541	TOTAL DAILY RIDERSHIP
14	AVG. DAILY RIDERSHIP
18%	HAVE A PLACE TO SIT
10%	PROVIDE A SHELTER
28%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
49%	ARE FAR-SIDE STOPS
90%	HAVE PARKING RESTRICTIONS



Menlo Park

SOUTH COUNTY

120	TOTAL BUS STOPS
1,412	TOTAL DAILY RIDERSHIP
12	AVG. DAILY RIDERSHIP
29%	HAVE A PLACE TO SIT
9%	PROVIDE A SHELTER
50%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
43%	ARE FAR-SIDE STOPS
86%	HAVE PARKING RESTRICTIONS



Millbrae

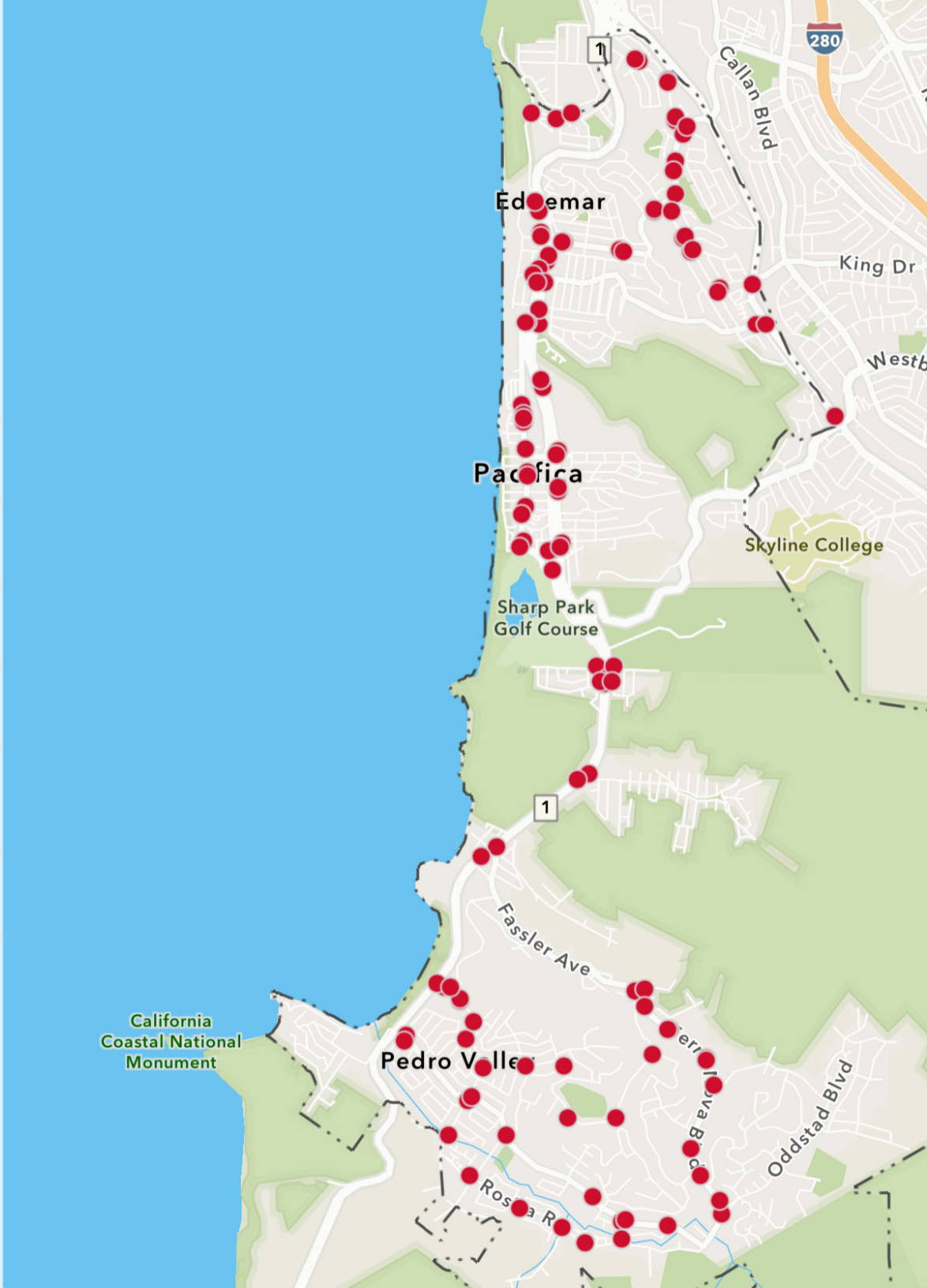
NORTH COUNTY

16	TOTAL BUS STOPS
1,354	TOTAL DAILY RIDERSHIP
85	AVG. DAILY RIDERSHIP
94%	HAVE A PLACE TO SIT
25%	PROVIDE A SHELTER
81%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
69%	ARE FAR-SIDE STOPS
100%	HAVE PARKING RESTRICTIONS

Pacifica

COASTSIDE

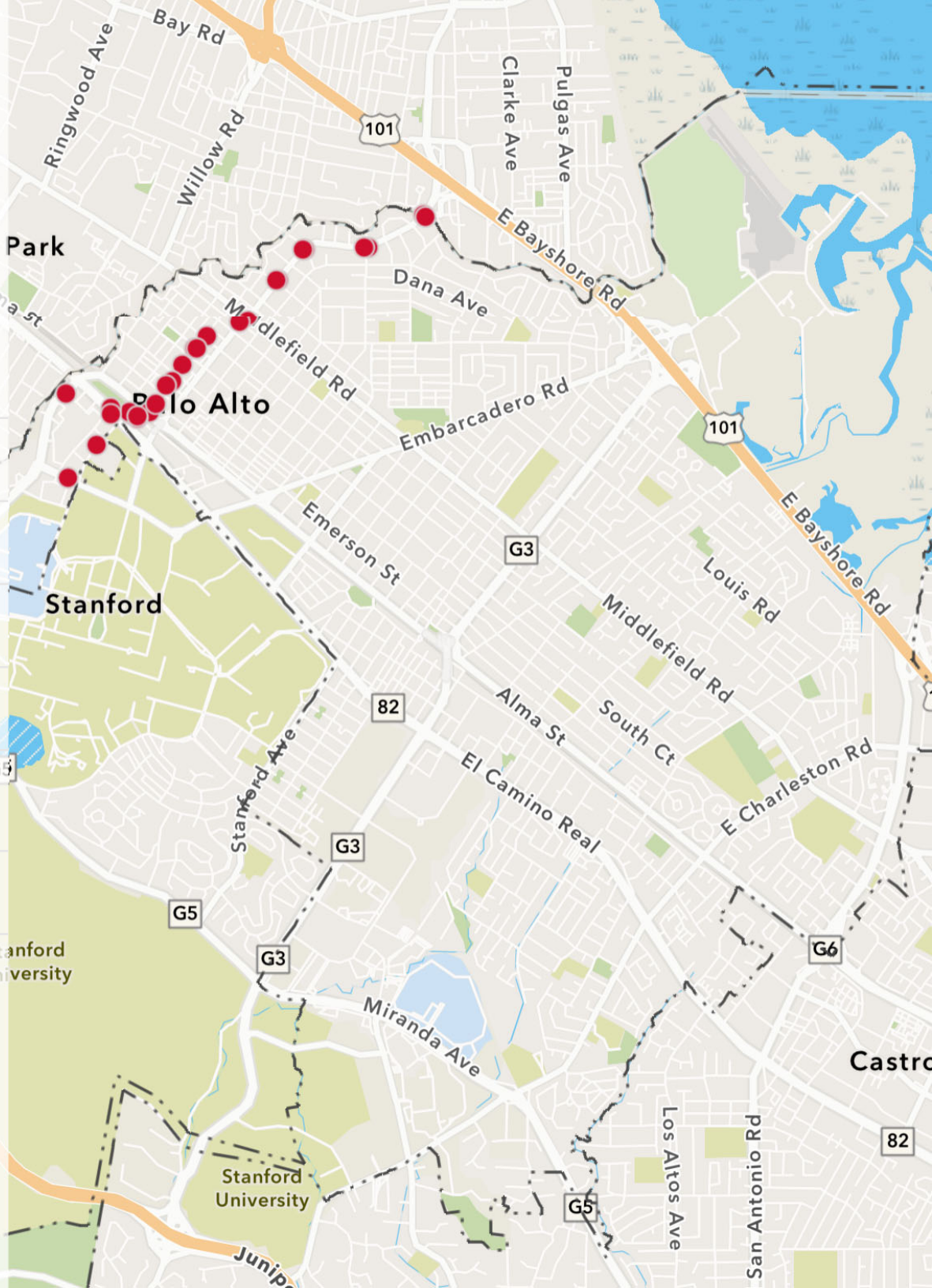
117	TOTAL BUS STOPS
1,933	TOTAL DAILY RIDERSHIP
17	AVG. DAILY RIDERSHIP
12%	HAVE A PLACE TO SIT
9%	PROVIDE A SHELTER
43%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
41%	ARE FAR-SIDE STOPS
60%	HAVE PARKING RESTRICTIONS



Palo Alto

SOUTH COUNTY

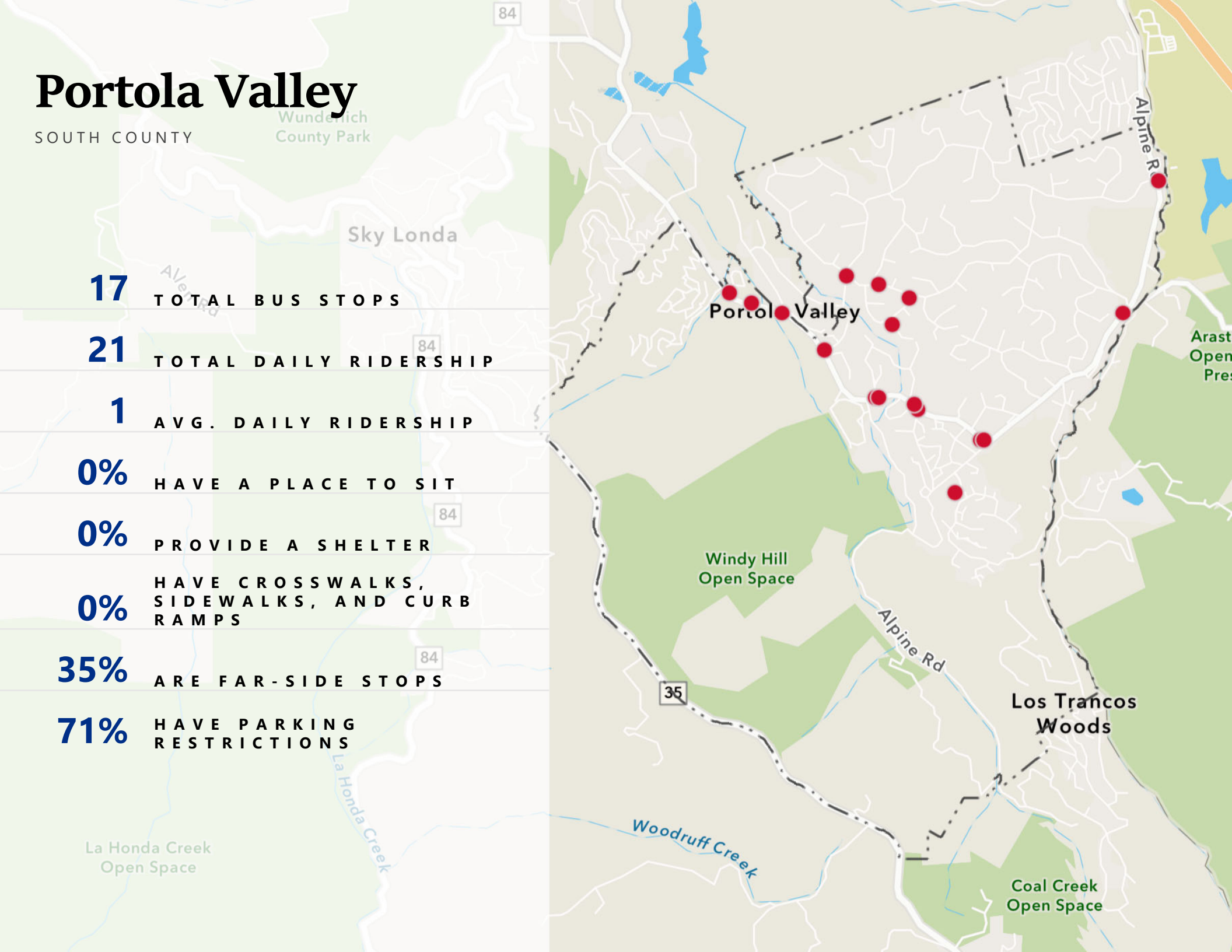
27	TOTAL BUS STOPS
1,560	TOTAL DAILY RIDERSHIP
58	AVG. DAILY RIDERSHIP
56%	HAVE A PLACE TO SIT
30%	PROVIDE A SHELTER
67%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
44%	ARE FAR-SIDE STOPS
100%	HAVE PARKING RESTRICTIONS



Portola Valley

SOUTH COUNTY

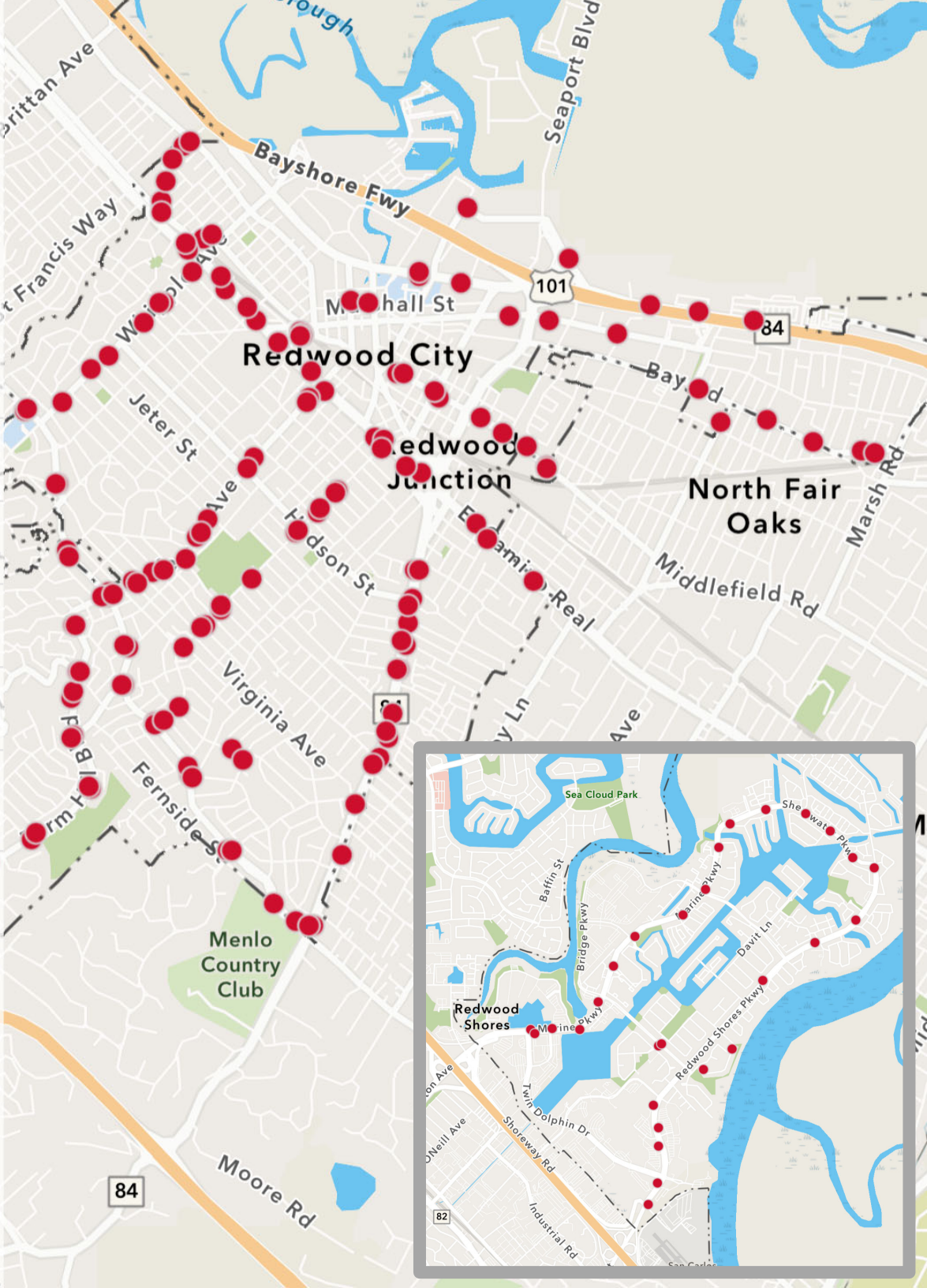
17	TOTAL BUS STOPS
21	TOTAL DAILY RIDERSHIP
1	AVG. DAILY RIDERSHIP
0%	HAVE A PLACE TO SIT
0%	PROVIDE A SHELTER
0%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
35%	ARE FAR-SIDE STOPS
71%	HAVE PARKING RESTRICTIONS



Redwood City

MID COUNTY

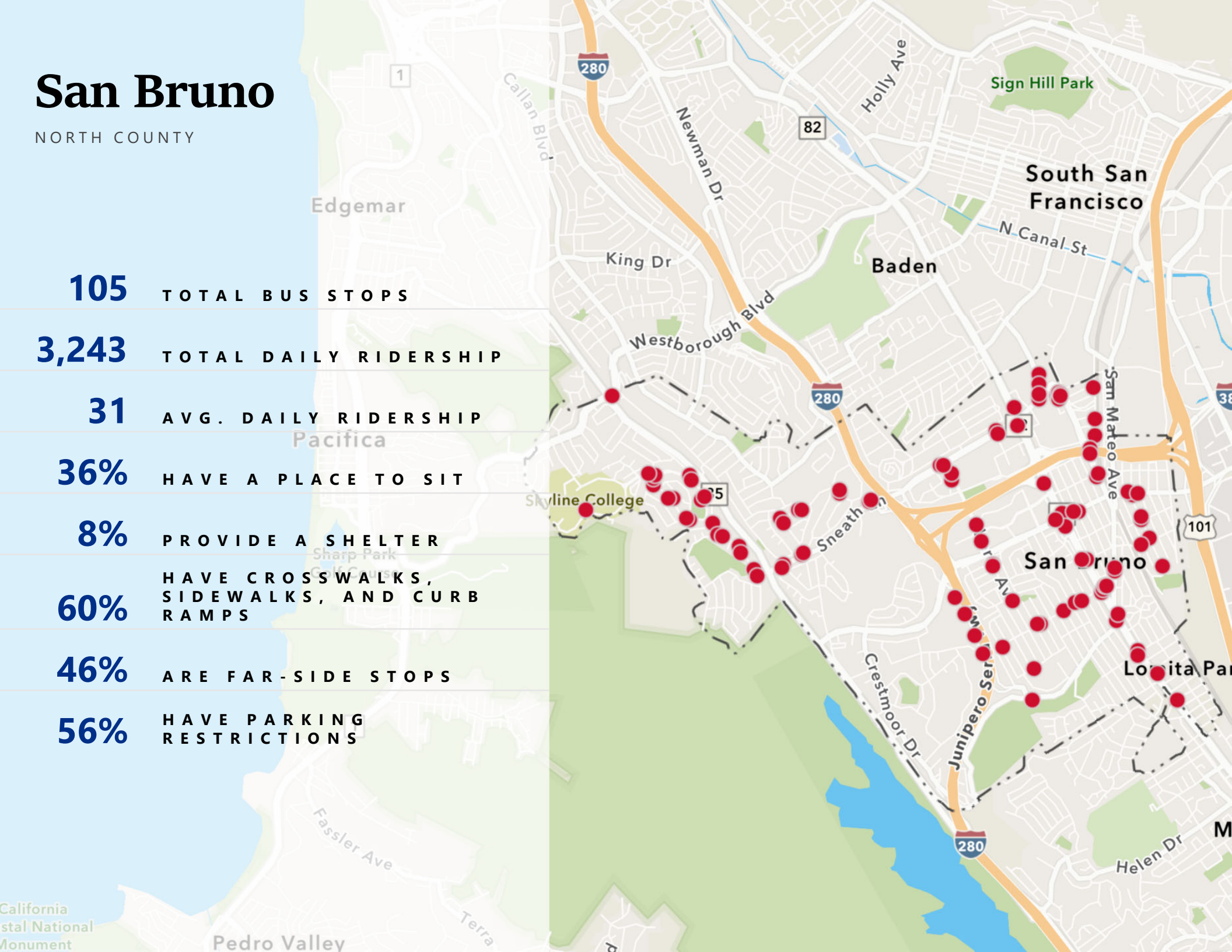
180	TOTAL BUS STOPS
4,159	TOTAL DAILY RIDERSHIP
23	AVG. DAILY RIDERSHIP
30%	HAVE A PLACE TO SIT
9%	PROVIDE A SHELTER
59%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
57%	ARE FAR-SIDE STOPS
77%	HAVE PARKING RESTRICTIONS



San Bruno

NORTH COUNTY

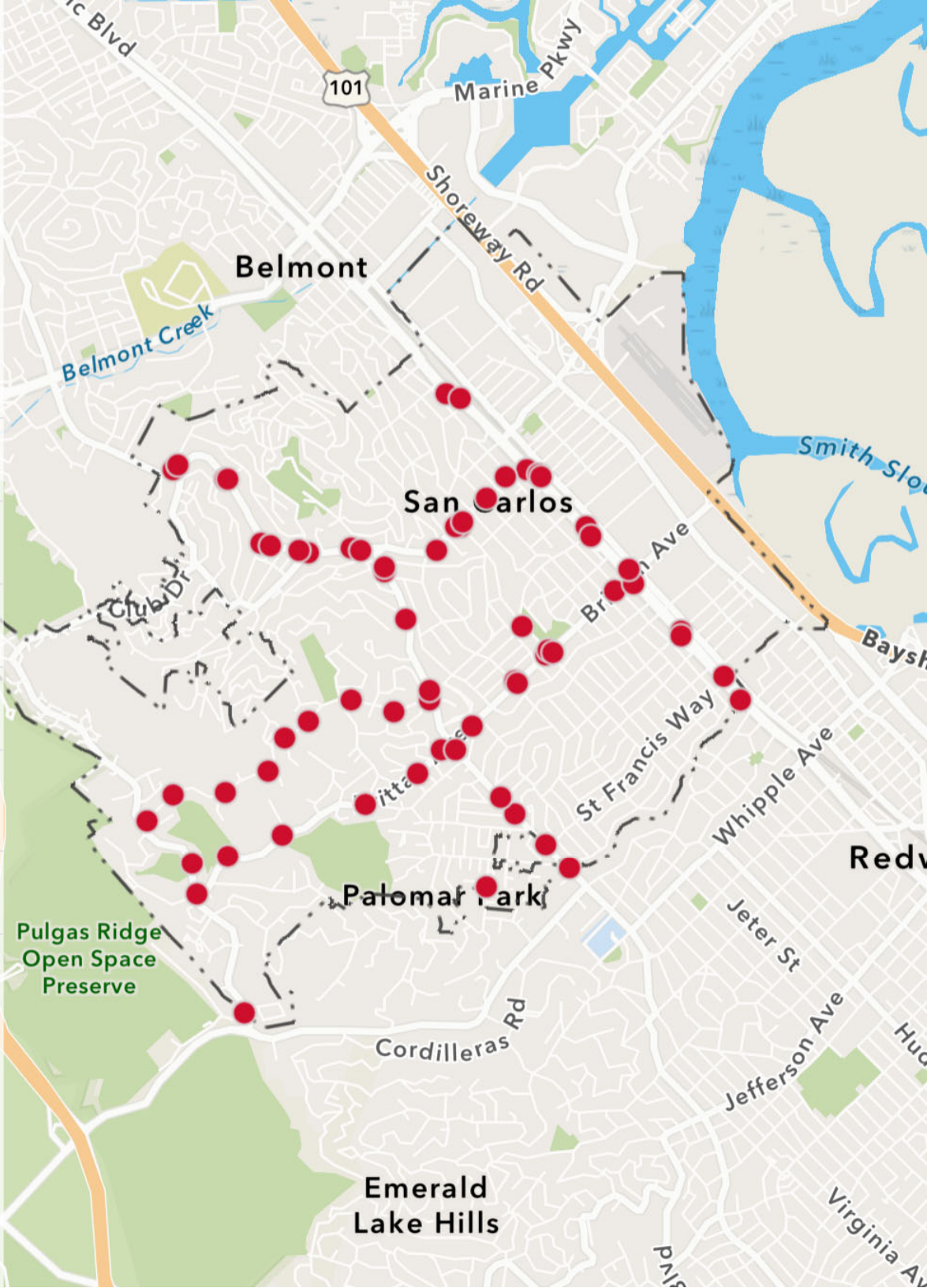
105	TOTAL BUS STOPS
3,243	TOTAL DAILY RIDERSHIP
31	AVG. DAILY RIDERSHIP
36%	HAVE A PLACE TO SIT
8%	PROVIDE A SHELTER
60%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
46%	ARE FAR-SIDE STOPS
56%	HAVE PARKING RESTRICTIONS



San Carlos

MID COUNTY

64	TOTAL BUS STOPS
1,232	TOTAL DAILY RIDERSHIP
19	AVG. DAILY RIDERSHIP
20%	HAVE A PLACE TO SIT
5%	PROVIDE A SHELTER
48%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
58%	ARE FAR-SIDE STOPS
53%	HAVE PARKING RESTRICTIONS



San Francisco

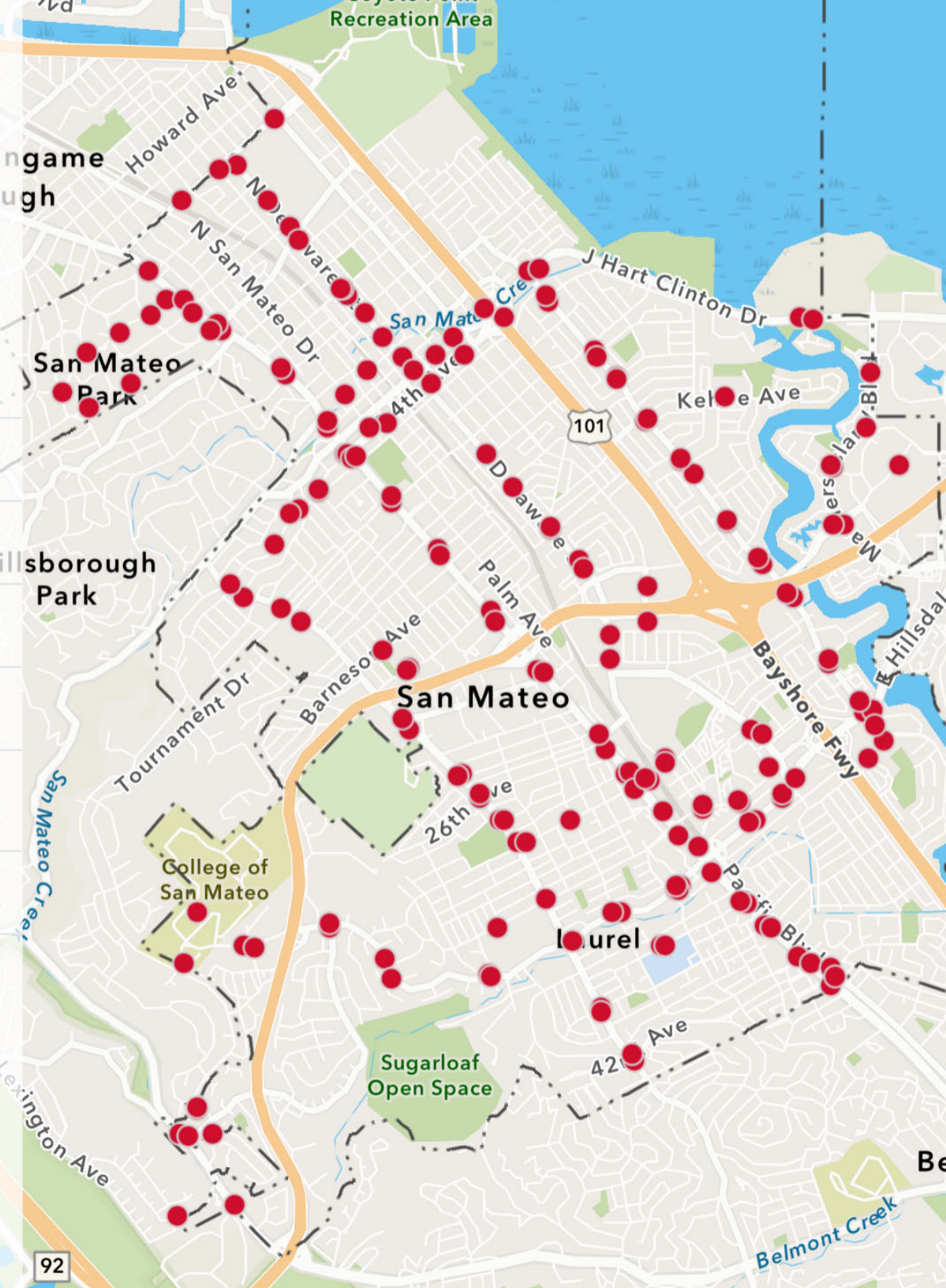
NORTH COUNTY

58	TOTAL BUS STOPS
2,281	TOTAL DAILY RIDERSHIP
39	AVG. DAILY RIDERSHIP
41%	HAVE A PLACE TO SIT
38%	PROVIDE A SHELTER
64%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
72%	ARE FAR-SIDE STOPS
84%	HAVE PARKING RESTRICTIONS

San Mateo

MID COUNTY

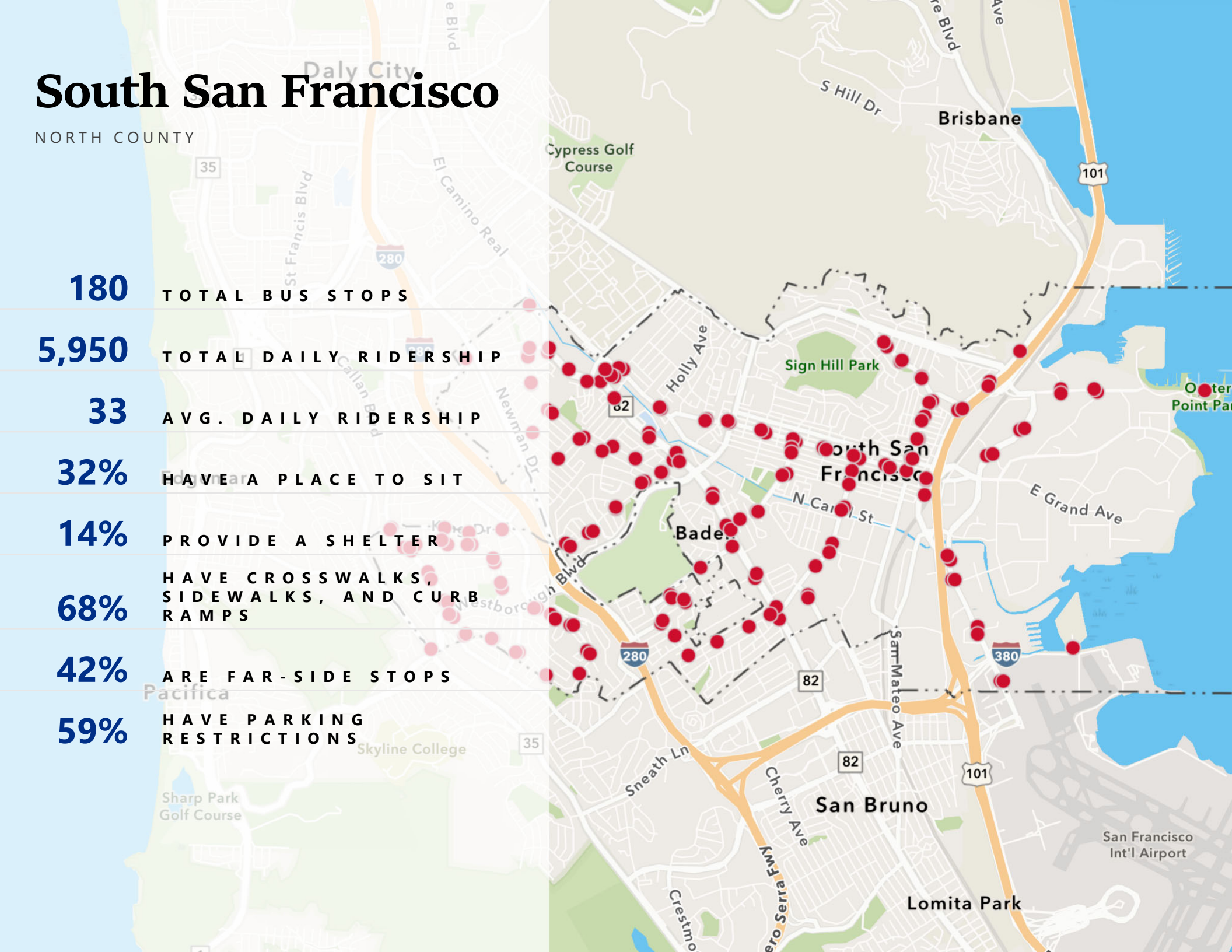
191	TOTAL BUS STOPS
7,171	TOTAL DAILY RIDERSHIP
38	AVG. DAILY RIDERSHIP
32%	HAVE A PLACE TO SIT
15%	PROVIDE A SHELTER
70%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
55%	ARE FAR-SIDE STOPS
73%	HAVE PARKING RESTRICTIONS



South San Francisco

NORTH COUNTY

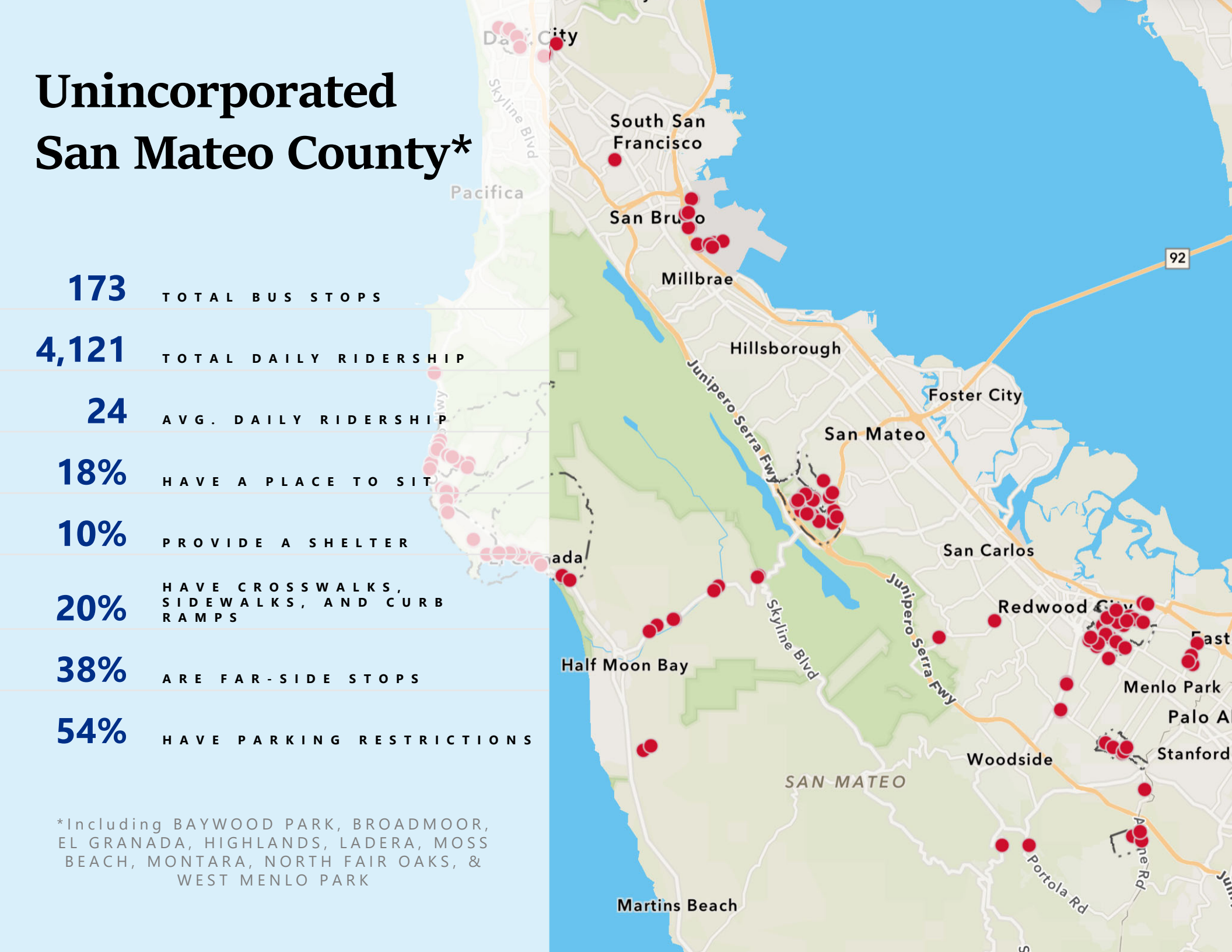
180	TOTAL BUS STOPS
5,950	TOTAL DAILY RIDERSHIP
33	AVG. DAILY RIDERSHIP
32%	HAVE A PLACE TO SIT
14%	PROVIDE A SHELTER
68%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
42%	ARE FAR-SIDE STOPS
59%	HAVE PARKING RESTRICTIONS



Unincorporated San Mateo County*

173	TOTAL BUS STOPS
4,121	TOTAL DAILY RIDERSHIP
24	AVG. DAILY RIDERSHIP
18%	HAVE A PLACE TO SIT
10%	PROVIDE A SHELTER
20%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
38%	ARE FAR-SIDE STOPS
54%	HAVE PARKING RESTRICTIONS

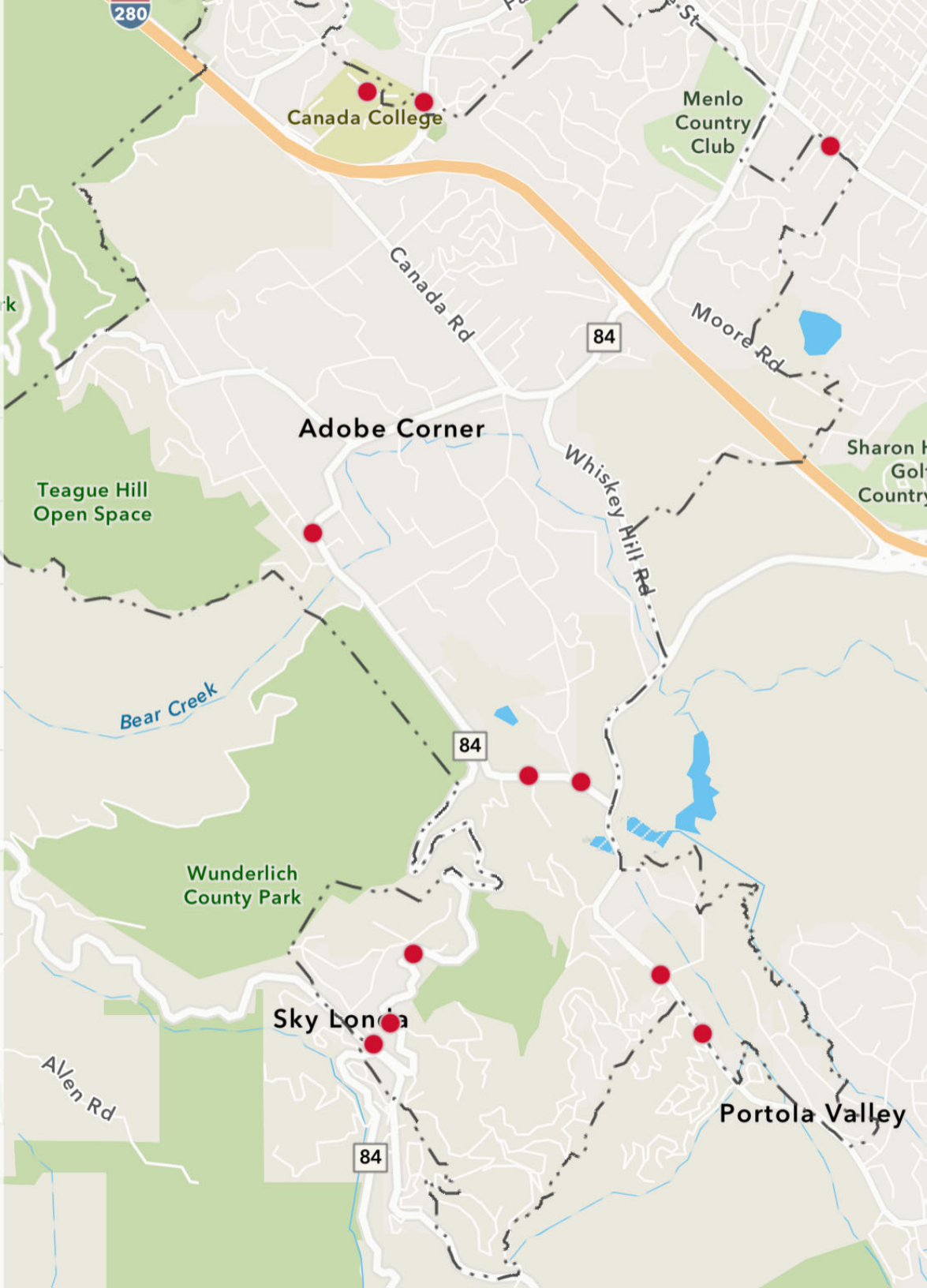
*Including BAYWOOD PARK, BROADMOOR, EL GRANADA, HIGHLANDS, LADERA, MOSS BEACH, MONTARA, NORTH FAIR OAKS, & WEST MENLO PARK



Woodside

SOUTH COUNTY

11	TOTAL BUS STOPS
112	TOTAL DAILY RIDERSHIP
10	AVG. DAILY RIDERSHIP
0%	HAVE A PLACE TO SIT
0%	PROVIDE A SHELTER
18%	HAVE CROSSWALKS, SIDEWALKS, AND CURB RAMPS
36%	ARE FAR-SIDE STOPS
73%	HAVE PARKING RESTRICTIONS



FEHR PEERS

Appendix A: BSIP Bus Stop Inventory Methodology

Date: December 2022

To: Daniel Shockley, SamTrans

From: Natalie Chyba and Sean Reseigh, Fehr & Peers

Subject: SamTrans Bus Stop Improvement Plan | Bus Stop Inventory Methodology

LA22-3373

Fehr & Peers prepared a bus stop inventory that acts not only as the backbone for the SamTrans Bus Stop Improvement Plan, but ideally will continue to serve SamTrans long after this project is complete. Fehr & Peers utilized a combination of existing SamTrans datasets, aerial imagery, and Google Street View to develop an inventory inclusive of transit service, amenities, typology, and environment characteristics.

This document is intended to serve an internal resource documenting the methodology for inventorying SamTrans' 1,871 stops.

Bus Stop Attributes

SamTrans is in the process of rolling out their ReImagine SamTrans network in three phases, with the first phase in early August 2022. Given this, Fehr & Peers focused the bus stop inventory on bus stops included in the ReImagine SamTrans network. The ReImagine SamTrans Phase 1 bus stop inventory served as the base file[1]. Please see **Attachment A** for attribute assumptions and sample photos for each amenity.

Table 1: Bus Stop attributes and data sources

Feature	Attributes	Description	Source
Transit Service	Bus Stop ID	--	SamTrans dataset
	Routes	List of routes serving stop	SamTrans dataset
	Ridership	Stop-level ridership	SamTrans APL dataset
	Other agencies	Other agencies who use the stop	Street View
Amenities	Standard pole & sign	Yes/No/Unable to verify	Street View

[1] Provided by SamTrans on 7/27/22

Feature	Attributes	Description	Source
	Real-time information	Yes/No/Unable to verify	Street View
	System map	Yes/No/Unable to verify	Street View
	System schedule	Yes/No/Unable to verify	Street View
	Shelter	Standard Ad-Shelter/Alternate/No/ Unable to verify	Street View
	Bench	Quantity/Unable to verify	Street View
	Simme Seat	Quantity/Unable to verify	Street View
	Trash receptacle	Quantity/Unable to verify	Street View
Stop Typology	Location	Transit center/In-lane/Pull-out/Mid-intersection	Aerial
	Position	Near-side/Far-side/Midblock	Aerial
	Stop length (ft)	Quantity/Unable to verify	Aerial
	Bus Pad	Yes/No/Unable to verify	Aerial
	Red curb	Yes/No/Unable to verify	Street View
	On-street parking at bus stop	Yes/No/Unable to verify	Street View
Stop Environment	Crosswalk	Yes/No/NA	Aerial
	Crosswalk Control Type	Signalized/PHB/RRFB/Stop-controlled/Uncontrolled/NA	Street View
	Sidewalk	Yes/No	Aerial
	Curb Cuts/Ramps	Yes/No/NA/Unable to verify	Aerial
	Possible sidewalk obstruction	Yes/No/NA/Unable to verify	Aerial/Street View
	Driveway conflict	Yes/No/Unable to verify	Aerial/Street View
Misc.	Google Map URL	--	Automated data pull
	Street View Date	Year	
	Notes	[text field with misc. notes on atypical conditions]	Aerial/Street View

Bus Stop Contextual Data

In addition to the bus stop inventory, Fehr & Peers consolidated and analyzed data related to the surrounding transportation and land use context to be used for identifying and prioritizing bus stop improvements. These datasets are summarized in **Table 2**. Each attribute is assigned to bus stops at a radius of 50 feet.

Table 2: Contextual data factors

Data Layer	Description	Source
SamTrans Stops	Bus stops effective 8/7/22 (ReImagine SamTrans Phase 01 Roll-out)	SamTrans
SamTrans Ridership	Average daily ridership (Ons+Offs) for September 2022	SamTrans
Census Places	Census-designated communities.	U.S. Census
Roadway Classification	Roadway classification by segment as defined by OpenStreetMap	OpenStreetMap
Injury Collisions	Injury collisions by mode throughout the service area from 2017-2021	Transportation Injury Mapping System/ Statewide Integrated Traffic Records System
Existing Bike Facilities	Existing bike facilities by classification	C/CAG Bike Plan
Daily Average Observed Speeds	Daily average observed speeds on all OpenStreetMap segments with available data throughout the service area. Data collected in 2019.	Wejo
Activity Density	The sum of population and jobs by census block group	American Community Survey 2019 5-Year Estimates
Vulnerability Index Tracts	Heat index scores in alignment with the SamTrans Adaptation and Resilience Plan	SamTrans
Equity Priority Areas	SamTrans Equity Priority Areas, as used in the Reimagine SamTrans effort	SamTrans

Bus Speed and Reliability

A bus speed and reliability analysis was conducted utilizing network-wide automatic passenger count (APC) data from September 2022. Bus runs were summarized to understand how bus travel times, speeds, and variability differ across routes, roadway segments, day parts, and day types. Roadway segments were defined at natural breakpoints in the transportation network, usually correlating with the location of bus stops. Day parts were defined in alignment with the MTC regional travel demand model day parts to include early AM (12-6am), AM (6-10am), Midday (10am-3pm), PM (3-7pm), and Evening (7pm-12am). Day types were as defined in the SamTrans APC data – weekday, Saturday, and Sunday. For each segment, day part, and day type, the following metrics were calculated:

- Travel time
- Median speed
- Variability, including:

- Buffer index: FHWA defines the buffer time as the difference between the 95th percentile and mean travel time for a segment. The buffer index is the buffer time divided by the mean travel time.
- Standard deviation of speed over mean speed
- Standard deviation of travel time over mean travel time

These metrics were only reported for segments that had at least ten runs for each respective day part and day type.

Bus speed and reliability data is visualized in the project's dashboard and can be used over the course of the project to determine 1) prioritization of bus stop improvements and 2) type of operational improvements needed.

Technical Workflow

The bus stop inventory workflow was a two-pronged approach, using Google Street View and aerial imagery as a reference point for validation and entry into an existing SamTrans bus stop feature class (Esri geodatabase format). The bus stop feature class was pre-populated with the following fields at the kickoff of inventory:

- Stop ID
- Stop name
- Latitude & longitude
- Static & dynamic URLs of the bus stop locations in Google Street View
- Field observer (staff who inventoried bus stop)
- QAQC reviewer
- Additional comments
- *All attributes listed in Table 1*

To standardize input values for each of the features outlined in Table 1, attribute domains were assigned to each bus stop feature. For example, the Standard pole & sign feature attribute had a dropdown that allowed for the input of only "Yes" or "No". To account for more specific observations about a particular bus stop feature that cannot be quantified within one of the pre-set attribute domains, a "additional comments" field was added to allow for manual input of these observations.

Once the schema of the bus stop feature class was finalized, Fehr & Peers staff inventoried each bus stop and their respective features within their assigned area of coverage for that particular day/week. Inventory occured in a web application built using ESRI web-app builder to allow multiple staff to update the database simultaneously.

After the completion of the manual inventory of bus stop features, other contextual data layers (Table 2) were analyzed in proximity to each bus stop. Attributes such as the roadway classification of the roadway that services a bus stop, number of injury collisions within proximity to a bus stop, and the presence of adjacent bicycle facilities are a few examples of contextual factors that were added to the final, inventoried bus stop dataset.

Quality Control

A standardized QA/QC process was applied throughout the entirety of the bus stop inventory to ensure a consistent workflow and that all collected data is accurate. At the end of each week, staff were randomly assigned 15 stops inventoried by another staff member to review. Additionally, the project management team reviewed 5% (~100 bus stops) inventoried by different staff in various locations within the SamTrans service area. This was to potentially uncover systemic issues that may occur at a less granular level. This resulted in 25% of all inventoried stops being QA/QC'ed in addition to systemic issues being uncovered.

Table 3: QC Concerns and Approach

Potential Concern	Approach to addressing
Repetitive data entry may lead to errors	• Spreading task across five staff to minimize burnout through the week • Developing a form within ESRI to minimize data entry errors (users will need to select from a drop-down)
Each staff person may interpret conditions differently	• Utilizing precedent photos of various models of SamTrans amenities to train staff • Systemic QAQC approach to ensure staff review each other's work for consistency • Project management staff QAQC of select stops
Outdated Street View or poor image quality	• Field verification of select bus stops by SamTrans staff

Field Verification of Bus Stops

In cases where Google Street View is not sufficient for accurate bus stop inventory, SamTrans staff conducted site visits using the web application. Fehr & Peers suggested that stops that meet the following criteria were field verified by SamTrans staff:

- The bus stop is blocked in Street View (e.g., by a bus, car, or other object)
- There is visible construction activity in Street View at or around the bus stop

All stops had some form of available Street View, and over 95% of stops have Street View data that is less than five years old.

Data Management & Visualization

Fehr & Peers developed a dynamic data dashboard designed to easily visualize the bus stop and contextual data landscape. The dashboard was developed under the Esri suite of software using ArcGIS Dashboards. It is map-centric with supplemental infographics to highlight distribution/share of bus stop amenities within the entire SamTrans service area or within a user defined area. Additionally, there users can filter on specific amenities to highlight a subset of bus stops that meet a user defined criterion. The dashboard is dynamic in nature, with a map viewer that contains additional base data layers (Table 2) related to the surrounding transportation and land use landscape. These layers are toggleable and serve as a reference point when analyzing the bus stop data.

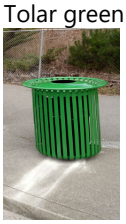
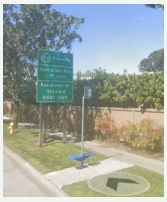
The dashboard was developed within Fehr & Peers' ArcGIS Enterprise. Following project completion, it will be transferred to SamTrans' (ArcGIS server, ArcGIS Online, ArcGIS Enterprise) using ArcGIS Assistant. All data will be compiled and delivered as a file geodatabase, which will contain the populated bus stop feature class and other contextual data used throughout the inventory and analysis process. A data dictionary of the bus stop data will also be provided to describe what each field within the data represents and the list of values found within each field.

Attachment A: Bus Stop Attribute Assumptions

Feature	Attributes	Description	Assumptions
Transit Service	Bus Stop ID	--	Base file is "SamTrans Stops – eff Aug7 2022" plus all new stop locations from the "Reimagine Final Implementation" file
	Routes	List of routes serving stop	Stop file joined to route file
	Ridership	Stop-level ridership	APC data
	Other agencies	Other agencies who use the stop	If other agencies' signs are on the stop, then they are listed.
Amenities	Standard pole & sign	Yes/No/Unable to verify	If sign was on a light post or other pole, "yes" was inputted with a comment.
	Real-time information	Yes/No/Unable to verify	--
	System map	Yes/No/Unable to verify	--
	System schedule	Yes/No/Unable to verify	--
	Shelter	Standard Ad-Shelter/Alternate/No/ Unable to verify	Standard Ad-Shelter – green shelter with ads Alternate – black or other type of shelter. If other type of shelter, details noted in "Additional Comments".
	Bench	Quantity/Unable to verify	Built in benches/seats in shelters were not counted
	Simme Seat	Quantity/Unable to verify	--
	Trash receptacle	Quantity/Unable to verify	--
Stop Typology	Location	Transit center/In-lane/Pull-out	In-lane – bus bulb or any location where the outer lane is <19' If parking is allowed, labeled as pull-out even if the presence of parked cars was observed.
	Position	Near-side/Far-side/Midblock/Mid-intersection	Mid-intersection – typically only at three-leg intersections Midblock – more than 250' from the nearest intersection
	Stop length (ft)	Quantity/Unable to verify	Measured as length of red curb or parking restriction If no red curb and parking is permitted, length = 0 Maximum length is 250'
	Bus Pad	Yes/No/Unable to verify	Only "yes" if concrete pad is at least 10' wide to reasonably accommodate width of a bus

	Red curb	Yes/No/Unable to verify	--
	On-street parking at bus stop	Yes/No/Unable to verify	--
Stop Environment	Crosswalk	Yes/No/NA	Yes/No – based on nearest intersection. Crosswalks must be on (n-1) legs of the intersection, where n is the number of legs. Midblock – NA if there is not a midblock crosswalk
	Crosswalk Control Type	Signalized/PHB/RRFB/Stop-controlled/Uncontrolled/NA	If there is a crosswalk, input control type If "no" or "NA" crosswalk, input NA
	Sidewalk	Yes/No	Determined based on conditions between nearest intersection and bus stop.
	Curb Ramps	Yes/No/NA/Unable to verify	Determined based on conditions at nearest intersection. Curb ramps must be present on all corners of intersection. Driveways do not count as curb ramps.
	Possible landing pad obstruction	Yes/No/NA/Unable to verify	Anywhere where there is an obstruction near the bus stop that restricts the sidewalk to <8'. If on street parking is available, automatic "yes".
	Driveway conflict	Yes/No/Unable to verify	"Yes" if there is a driveway within 75' from the top of bus stop (min distance listed in 2013 SamTrans Bus Stop Guidebook for length between pole and nearest adjacent intersection)
Misc.	Google Map URL	--	Automated data pull
	Street View Date	Year	Automated data pull
	Additional comments	[text field with misc. notes on atypical conditions]	

Attachment A: Bus Stop Amenities Sample Photos

Amenity	Photo	Amenity	Photo
Typical benches	 Green Tolar  Composite wood bench  Green Tolar bench	Typical trash cans	 Precast concrete trash can  Tolar green trash can  Tolar green trash cans
Ad shelter (Tolar)		Simme Seat	
Alternate shelters	 SamTrans standard  Other agencies (MUNI)		