17th Avenue Pop-Up Protected Bike Lane

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Executive Summary

Purpose

The purpose of this report is to attract cycling to a broad group of cyclists by recommending the implementation of protected bike lanes in Santa Cruz. With our limited time, we focused on a critical site where protected bike lanes would be most useful to the surrounding community. 17th Avenue is an essential street due to its connectivity and access to schools and businesses, in addition to its connection to the Arana Gulch bike trail, which connects to downtown Santa Cruz. To widen the appeal of cycling along this street, we recommend implementing protected bike lanes along 17th Avenue from Felt Street through the intersection at Capitola Road. The implementation of protected bike lanes can increase the number of commuters who bike and improve road safety for all types of users. The benefits of protected bike lanes come at a low cost and require minimal infrastructural changes.

This Report:

- Assesses the bicycle facilities along 17th Avenue and identifies key segments along the street based on proximity to destinations (schools, businesses, recreation, etc.) and bicycle safety (collisions, traffic volumes, and travel speeds).
- Recommends feasible bike facilities that require minimal change to the already existing street dimensions and follows the National Association of City Transportation Officials

Development

The 17th Avenue Protected Bike Lanes report was developed as part of a senior seminar group project through the University of California, Santa Cruz. Jessica Ngo, Lydia Jenkins-Sleczkowski, Christina Eldredge, and Christopher Tom are Environmental Studies undergraduate students who worked with the help of Bike Santa Cruz County director Gina Cole and under the supervision of Professor Adam Millard-Ball to develop this report.

Introduction

Biking is an important part of the Santa Cruz culture due to the fact that the city is turning a leaf and working towards environmentally friendly and green initiatives. Unfortunately, only a small percentage of bicycle trips are taken due to the lack of effective bicycle facilities. Other than distance and hilly topography, safety could be a major reason why more people do not bike. Due to the lack of separation between bikes and cars, cyclists are riding next to cars, which intimidates the less confident cyclists. Protected bike lanes are the perfect opportunity to provide all types of cyclists with the safety they need to ride confidently. This report analyzes how the implementation of protected bike lanes in a designated area will make Santa Cruz more accessible.

This report identifies a key area where protected bike lanes could be implemented to increase bike ridership. We will characterize a subset of corridors based on bicycle safety and need for improvement. We will partner with Bike Santa Cruz County to gather bike counts and the opinions of businesses and residents to get a better sense of how a protected bike lane will aid in the safety of residents and community cyclists utilizing the street during all parts of the day. Though this project is officially starting as a short-term program along just two blocks of the street, we hope to present data and highlight the positives of not only making this protected bike lane permanent, but also one that can be achieved in the long term.

The segment of 17th Avenue from Felt Street through the intersection at Capitola Road was identified as the site of interest. Figure 1 highlights the main elements to consider for the implementation of protected bike lanes along 17th Avenue. 17th Avenue connects residential neighborhoods to various storefronts, restaurants, and schools. 17th Avenue also has the potential to connect the east-side residents to the Arana Gulch, and thus connecting residents to downtown Santa Cruz. Unfortunately, the lack of bicycle infrastructure is uninviting to cyclists, particularly children attending the nearby schools.

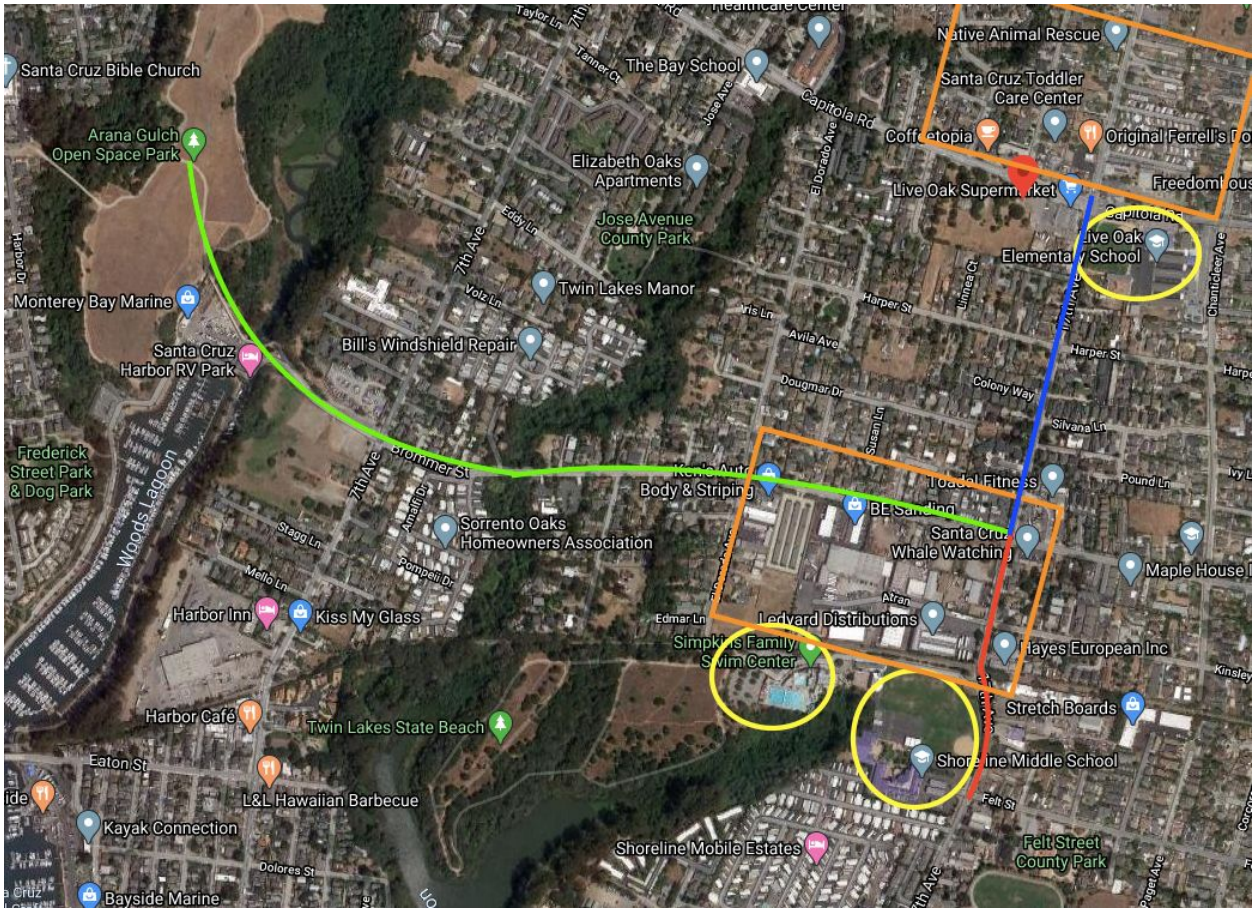

Figure 1. 17th Avenue shown with significant features for the 17th Avenue Protected Bike Lane Project. The red line indicates where Bike Santa Cruz County plans to implement their pop-up protected bike lane. The blue line shows where we wish to extend the protected bike lane. The green line shows the connection from Brommer Street to the Arana Gulch trail. The orange squares highlight the businesses and shops and the yellow circles highlight the schools and the Simpkins Swim Center.

A pop-up protected bike lane, by Bike Santa Cruz County, will be implemented on 17th Avenue, in the Live Oak district of Santa Cruz. In preparation for the pop-up protected bike lane demonstration during National Bike Month in May, we recommend a consideration of 1) installing permanent protected bike lanes along 17th Avenue in the long term, and 2) extending Bike Santa Cruz County's planned pop-up to extend an additional two blocks north, from Brommer Street to Capitola Road.

By adding protection to the existing bike lane we believe more people will feel comfortable in their daily commutes, especially in regards to the safety this divider ensures for children and families moving to and from school every day. We also believe that extending the project an additional two blocks can further incentivize biking in Santa Cruz while also benefiting the local businesses and centers located along the road.

Existing Conditions

The goal of the pop up bike lane is to increase bicycle ridership and create a safe environment for younger cyclists. The section of 17th Avenue between Brommer Street and Felt Street was chosen because of its proximity to the middle school and elementary schools, swim center, and direct connection to the Arana Gulch bike path. The extension through Capitola Road was chosen also because of its proximity to the schools and businesses.

The following section describes the existing conditions of the current bicycle infrastructure along 17th Avenue and outlines surveys from parents at the schools. From this data, we identify a focus for our design recommendations.

Setting

17th Avenue, between Felt Street and Capitola Road, is poised in a unique place to pilot a protected bike lane in Santa Cruz, and will be adding to the currently low number of protected bike paths in the county. Figure 1 highlights the mix of buildings and destinations, including Shoreline Middle School and Del Mar Elementary School, as well as the Simpkins Swim Center. Thus, this area sees significant traffic, particularly during rush hour timeframes (7:00-9:00 AM and 4:00-6:00 PM), and has a large number of children and youth riding to school and to the pool. Brommer Street leads directly to the Arana Gulch trail and 17th Avenue is considered a connector with the Live Oak residences and the bike-friendly trail leading to the Seabright neighborhood. The road's dimensions lend to the success of adding protection to its existing bike

lane. Figure 2 shows the current bike lane is 5 feet and 5 inches on average, the lane widths are 10 feet 9 inches, and the center turn lane is 10 feet and 7 inches, totalling 43 feet and 3 inches.

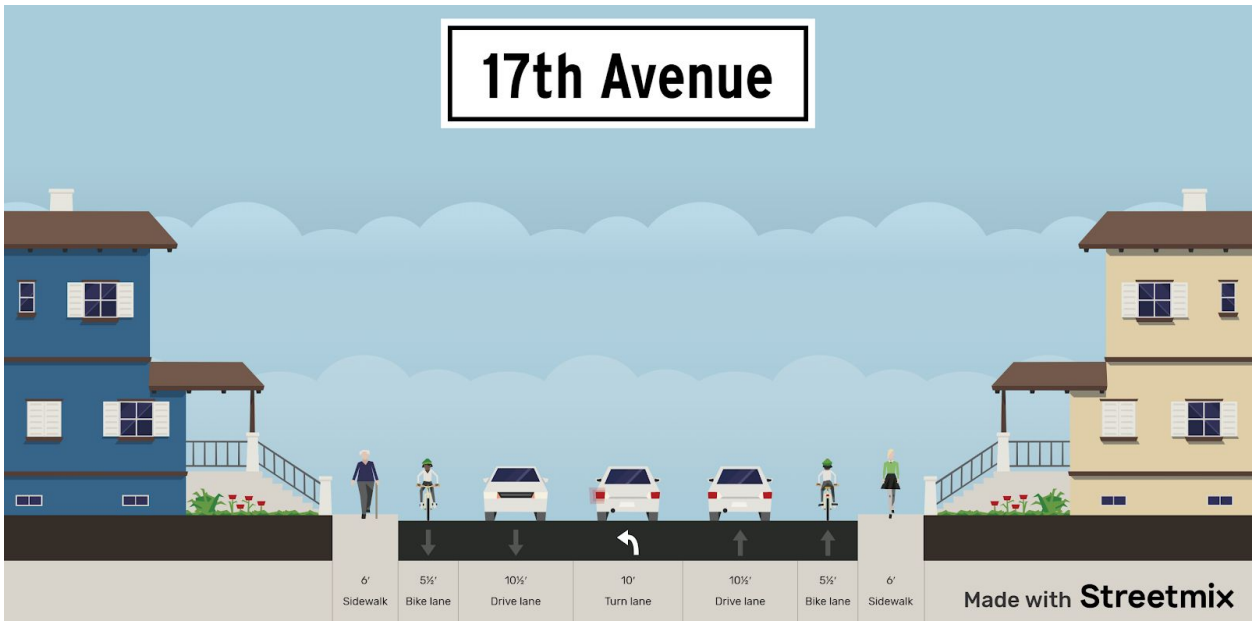

Figure 2. The current status of 17th Avenue and Harper Street

Traffic Count

Table 1: Traffic Count Data

Friday, 2/22, 7:45-8:45 AM				
Time	Center Turn Lane Cars	Bicyclist	Pedestrian	Trucks
7:45-7:59 AM	1	10	7	0
8:00-8:14 AM	7	17	20	3
8:15-8:29 AM	4	13	15	4
8:30-8:45 AM	8	9	7	2
Subtotal	20	39	49	9
Monday, 2/25, 4:45-5:45 PM				
4:45-4:59 PM	0	4	2	0
5:00-5:14 PM	0	7	6	0
5:15-5:29 PM	5	2	3	3
5:30-5:45 PM	1	1	9	1
Subtotal	6	14	20	4
TOTALS	26	53	69	13

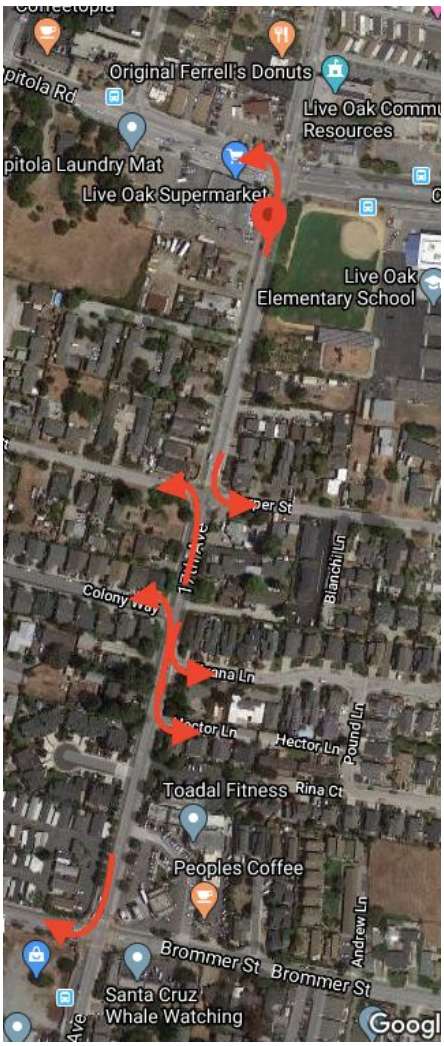

Figure 3. Significant turn lane traffic along between 17th Avenue and Brommer Street and 17th Avenue and Capitola Road

Initial surveying by Bike Santa Cruz County led us to believe we would need to remove the center turn lane. Therefore, we conducted our own traffic counts to determine the impacts of removing the center turn lane (Table 1). We conducted traffic counts during peak morning and evening periods to collect data on the number of cars using the center turn lane, the number of trucks using 17th Avenue, and the number of bicyclists and pedestrians. Figure 3 shows the significant turn lane traffic along this segment of 17th Avenue. A total of 30 cars turned onto Brommer Street at the intersection and Capitola Road at the intersection. 6 total cars turned into the residential areas on Harper Street and Silvana Lane. And a total of 2 cars turned onto Colony

Way and Hector Lane. Most of the cars were turning onto Brommer Street and Capitola Road, and therefore without the turn lane, the traffic on 17th Avenue would not be significantly impacted. From the data we gathered, we deemed the turn lane unnecessary, except at the Brommer and Capitola intersections.

Level of Traffic Stress

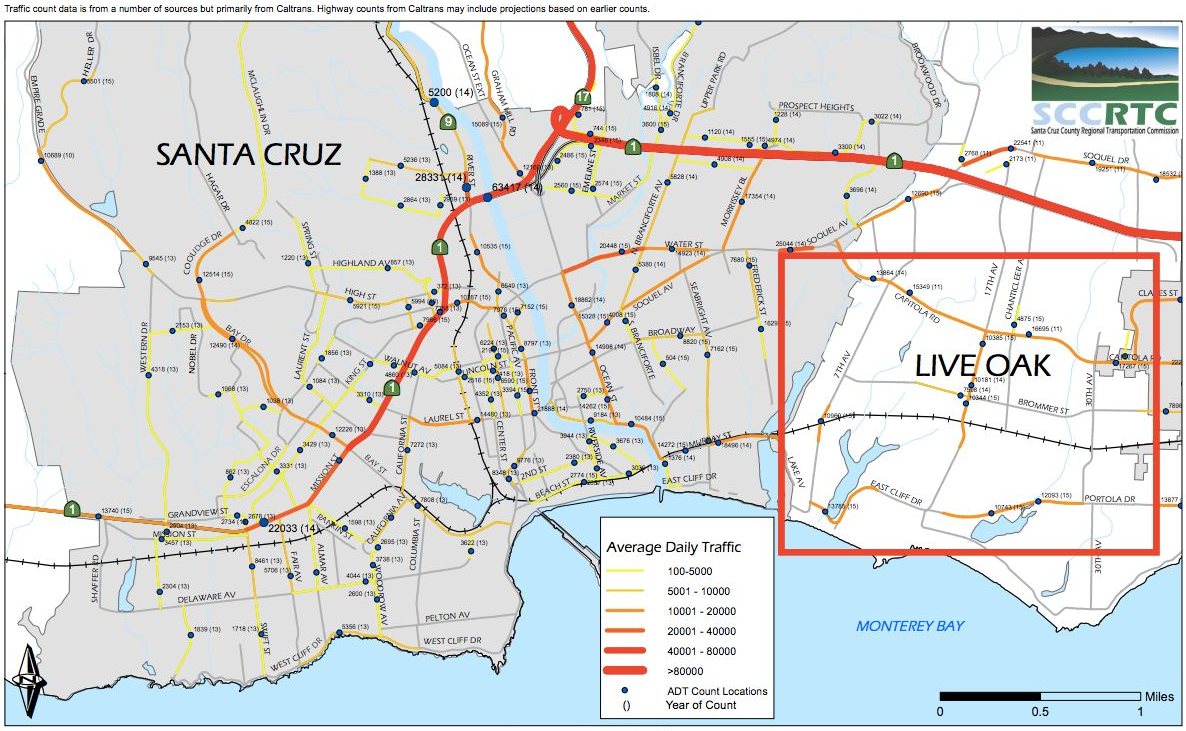

Figure 4. Average Daily Traffic Count. Source: Santa Cruz Active Transportation Plan

	Street Width		
Speed Limit or Prevailing Speed	2-3 lanes	4-5 lanes	6+ lanes
Up to 25 mph	LTS 1 [a] or 2 [a]	LTS 3	LTS 4
30 mph	LTS 2 [a] or 3 [a]	LTS 4	LTS 4
35+ mph	LTS 4	LTS 4	LTS 4

[a] Use lower value for streets without marked centerlines and with ADT ≤ 3000; use higher value otherwise.

Figure 5. A table that is used to calculate the level of traffic stress on a street.[1]

Figure 4 shows the average daily traffic (ADT) in Santa Cruz. The red box is our area of focus: 17th Avenue in the Live Oak District of Santa Cruz. According to the Dutch guidelines for bicycle infrastructure, referenced in the Level of Traffic Stress (LTS) criteria, ADT should be less than 5,000 if bikes are to operate with mixed traffic.[2] 17th Avenue is a street where ADT is between 10,000-13,000 and according to Dutch guidelines, this street requires a separated bike facility.[3] The speed limit on this stretch of 17th Avenue is 30 mph, and from our street surveys, it is prevalent that cars often travel above the speed limit. By observing car speeds on 17th Avenue, we were able to determine that a majority of cars were traveling at speeds closer to 40 mph, despite the speed limit. In addition, 17th Avenue has a total of 3 lanes: 2 driving lanes and 1 center turn lane. Figure 5 indicates 17th Avenue is at LTS 4 and therefore only appropriate for strong and fearless cyclists. The lack of protection on 17th Avenue discourages other types of cyclists from riding in this area. The lack of protection discourages less confident cyclists to ride

[1] Level of Traffic Stress is a common rating system that indicates how much stress a given combination of traffic volumes, speeds and (lack of) bicycle infrastructure imposes on cyclists. See the more detailed description at http://www.northeastern.edu/peter.furth/research/level-of-traffic-stress/

[2] How level of traffic stress can be calculated using ADT from http://www.northeastern.edu/peter.furth/research/level-of-traffic-stress/

[3] Average Daily Traffic on 17th Avenue from https://sccrtc.org/wp-content/uploads/2011/07/2011-06-adt-counts.pdf.

on this street. But despite the potentially hazardous conditions, there has been only one accident on 17th Avenue between 2008 and 2018.[4] However, the speeding cars still remain a threat to potential young bicyclists, especially considering that they may be less confident in their cycling abilities.

Community Outreach

Community outreach efforts in support of the existing conditions phase consisted of surveys and interviews. A description of each of these is provided below.

Surveys

Shoreline Middle School is one of the schools along 17th Avenue and within the area where the proposed pop-up bike lanes will be placed. Bike Santa Cruz County talked to parents as they were dropping off and picking up their children and gave surveys to students to give to their parents at Shoreline Middle School.[5] We modelled our surveying method from their methods. Students at Live Oak Elementary School were given surveys to give to their parents to gather information about their child's trip to and from school. This survey also reflects parents' perceptions regarding whether walking and bicycling to school is appropriate for their child. The data from this survey was collected using the Survey about Walking and Biking to School for Parents form the National Center for Safe Routes to School.

The results from Bike Santa Cruz County's survey with Shoreline Middle School and our survey with Live Oak Elementary School suggests parents are not comfortable with their children biking to school. Parents are mostly worried about speed of traffic, amount of traffic, and time. A protected bike lane will ease parents' worries about these issues. A protected bike lane will provide cyclists with a buffer and a larger separation from the fast moving traffic on 17th Avenue. Children will be safer because they will be further separated from the motor vehicles. With a clear separation from motorized vehicles, children will be able to bike more confidently

[4] Transportation Injury Mapping System

[5] Parent Survey Report from Shoreline Middle School
https://drive.google.com/file/d/0B5wuqnUQd7qqeDgtdms1YVM2QmozY0FjVG9LejVEYmM3VjBv/view

and potentially faster. If parents know their child will be safe, parents will more easily support their child biking to school.

*Because less than 30 surveys (a total of 24 surveys) were included in this report, each graph and table display counts rather than percentages.

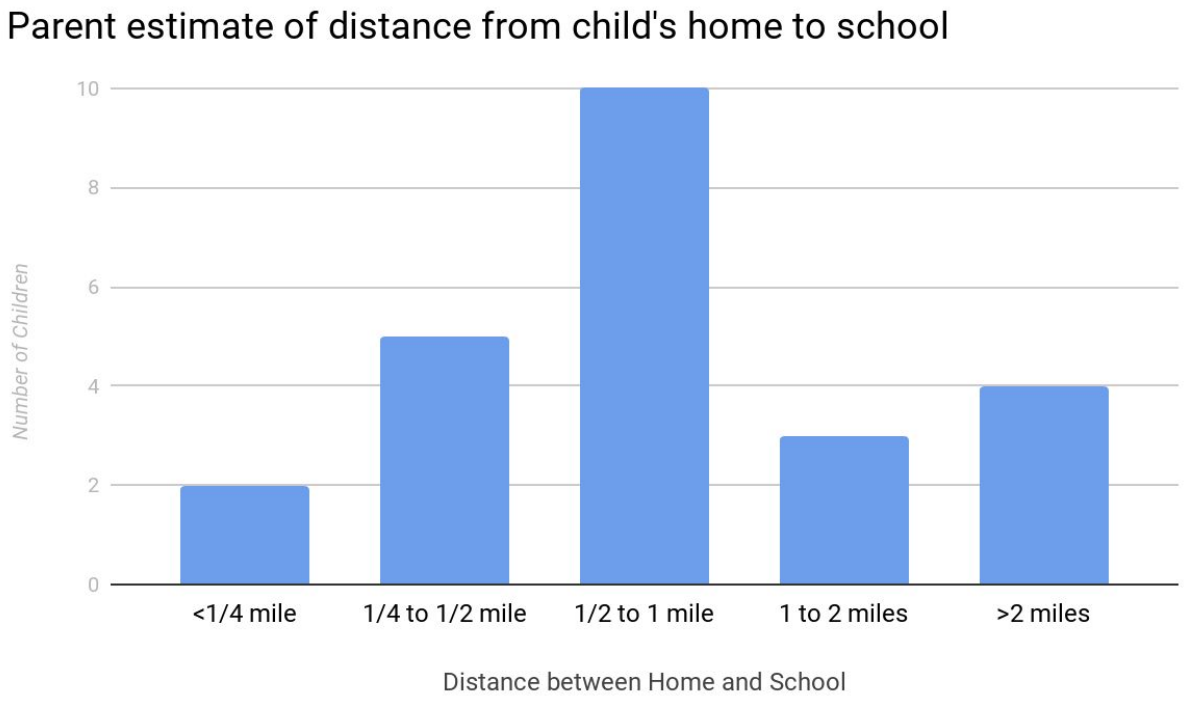

Figure 6. Distance student lives from home

Table 2. Parent estimate of distance from child's home to school

Distance between home and school	Number of children
Less than ¼ mile	2
¼ mile up to ½ mile	5
½ mile up to 1 mile	10
1 mile up to 2 miles	3
More than 2 miles	4

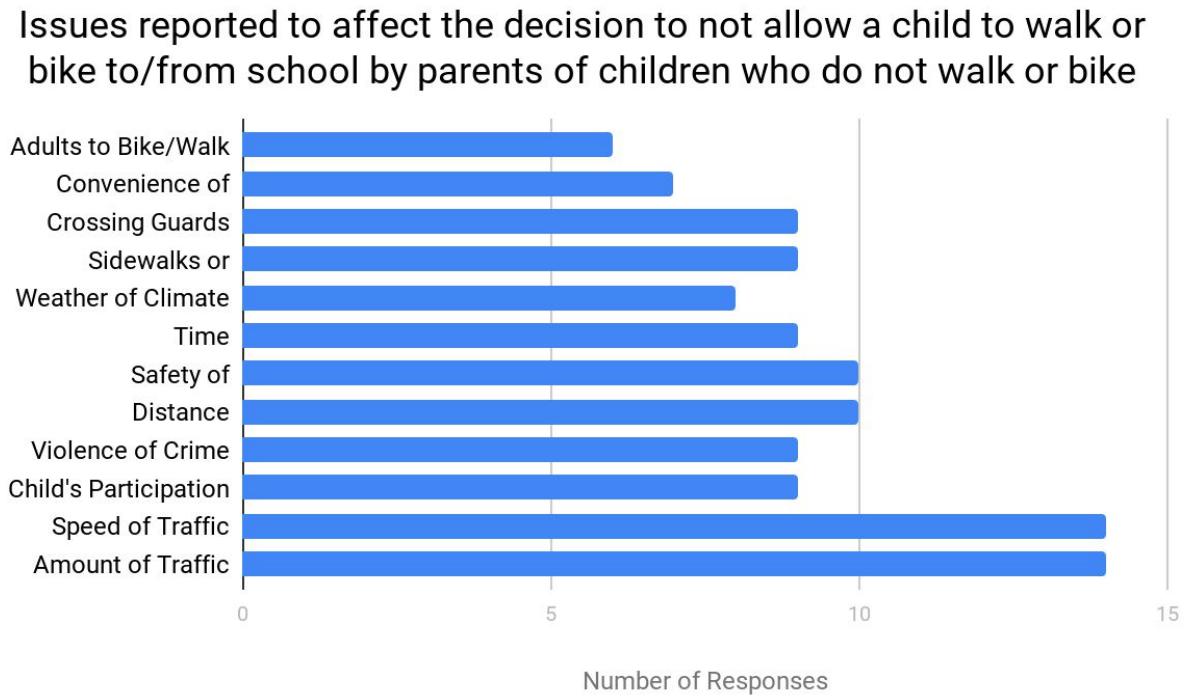

Figure 7. Issues from parents who do not allow child to walk or bike to/from school

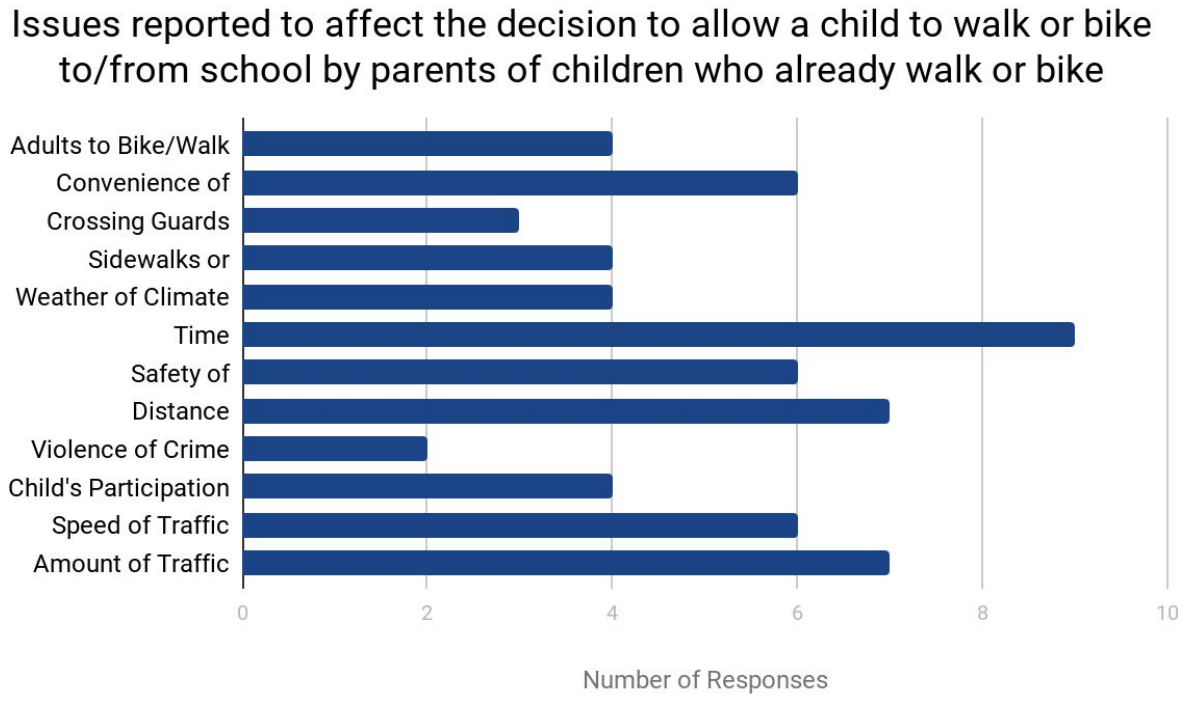

Figure 8. Issues from parents who allow child to walk or bike to/from school

Table 3. Issues reported to affect the decision to allow a child to walk or bike to/from school by parents of children who already walk or bike to/from school

Issue	Child does not walk/bike to school	Child walks/bikes to school
Adults to Bike/Walk With	6	4
Convenience of Driving	7	6
Crossing Guards	9	3
Sidewalks or Pathways	9	4
Weather or Climate	8	4
Time	9	9
Safety of Intersections and Crossings	10	6
Distance	10	7
Violence or Crime	9	2
Child's Participation in After School Programs	9	4
Speed of Traffic Along Route	14	6
Amount of Traffic Along Route	14	7

Interviews

Interviews were conducted with individual people from businesses and residents within the 17th Avenue and Brommer block as well as individuals from at Santa Cruz Farmers Market. In addition to answering prompted questions, individuals were asked to express their opinions and concerns about cycling around Santa Cruz. The conversations with individuals established baseline conditions and developed a shared understanding of the project's opportunities, challenges, goals, preferred outcomes, and the overall project approach. The questions used to facilitate discussions are listed below as well as the recorded responses to each question.

1. Do you own a bike?
2. How often do you ride your bike?
3. What do you ride for?
4. How far is your commute to work?
5. Is safety a concern for you when cycling?
6. Would a physical barrier separating cars and bikes reduce this concern?
7. Can we count on your support for our pop-up protected bike lane demonstration on 17th Avenue?

The results of the interviews suggest that a majority of the people ride a bike as a travel method rather than a motorized vehicle or walking. The people who bike are concerned about their safety and a majority of the people also said that physical barriers will ease these safety concerns. Because so many people are commuting to and from work, it would be beneficial to implement protected bike lanes to ease the worry and increase the safety of cyclists. But people do not bike just to commute to and from work. People bike for a variety of reasons ranging from fun to fitness. Therefore it is important to have protected bike lanes for all types of cyclists to be comfortable riding on the streets.

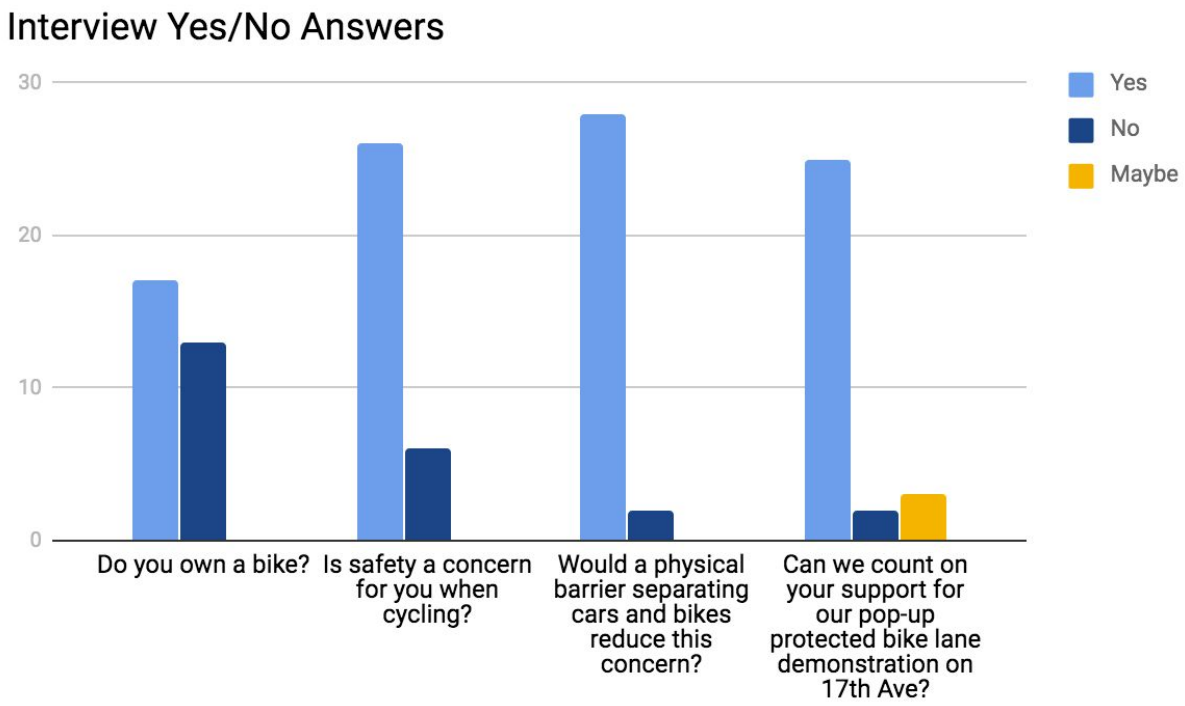

Figure 9. Yes/No interview answers

Table 4. Yes/No interview questions and answers

Do you own a bike?	Is safety a concern for you when cycling?	Would a physical barrier separating cars and bikes reduce this concern?	Can we count on your support for our pop-up protected bike lane demonstration on 17th Ave?
Yes: 17	Yes: 26	Yes: 28	Yes: 25
No: 13	No: 6	No: 2	No: 2
---------	----------	----------	Maybe: 3

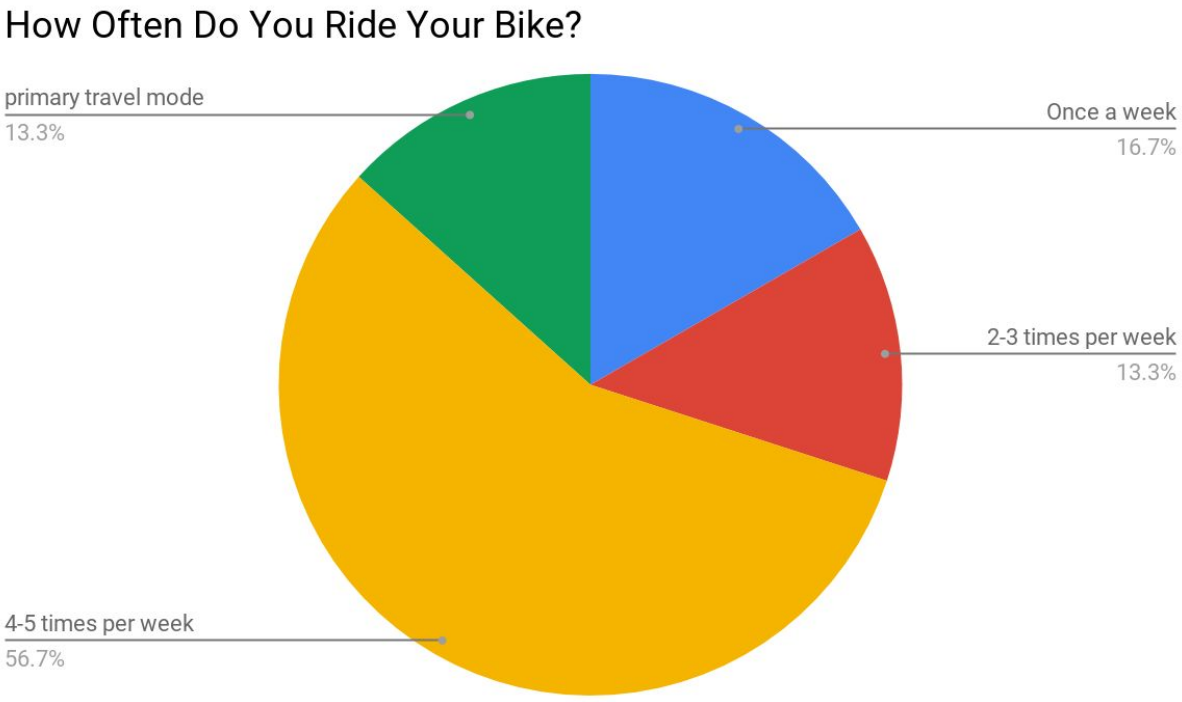

Figure 10. Percent of times people ride bikes per week

Table 5. How often do you ride your bike?

Once a Week	5
2-3 times per week	4
4-5 times per week	17
Primary travel mode	4

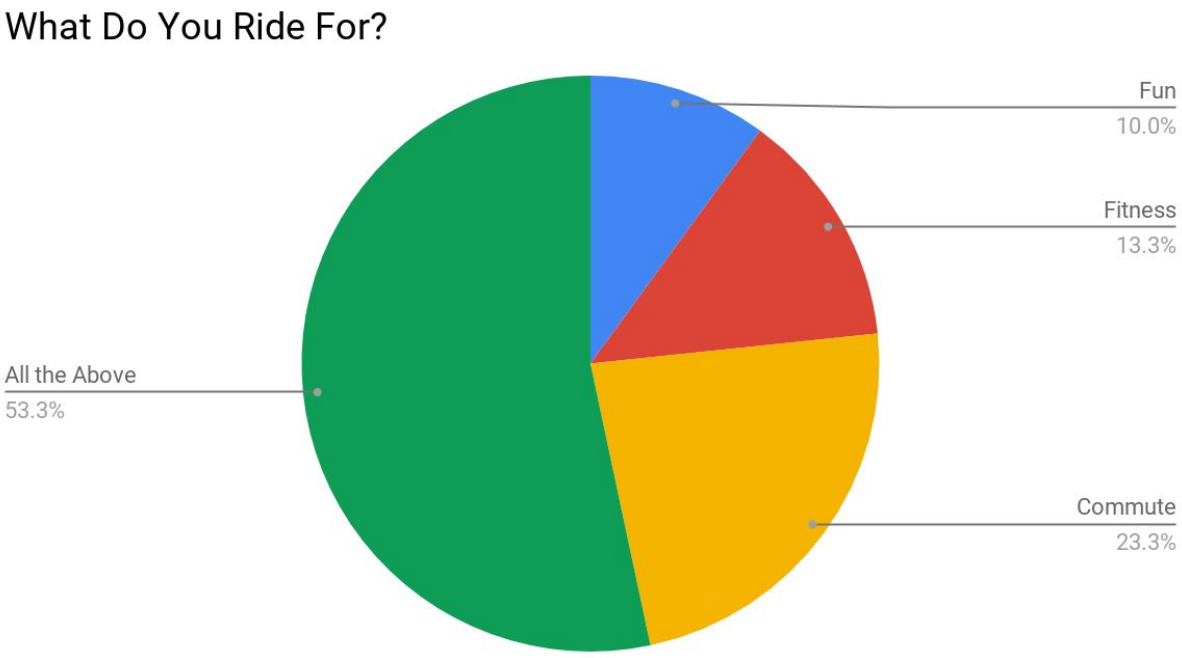

Figure 11. Percent of reasons why people ride bikes

Table 6. What do you ride for?

Fun	3
Fitness	4
Commute	7
All the Above	16

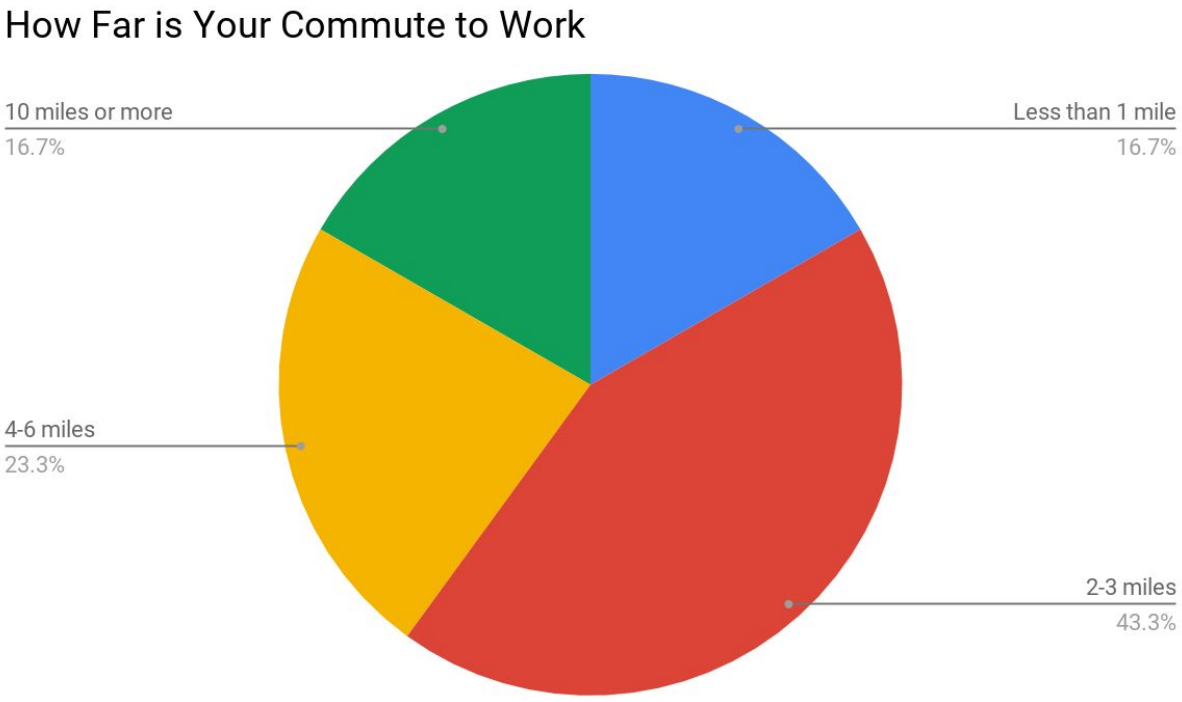

Figure 12. Percent of how far people live from their work place

Table 7. How far is your commute to work?

Less than 1 mile	5
2-3 miles	13
4-6 miles	7
10 miles or more	5

Recommendations

Overview

To start this recommendations section, we will overview some of the general design guidelines as used by the National Association of City Officials (NACTO). Following the overview, we will give detailed design recommendations for 17th Avenue that follow these guidelines. Simply, we recommend taking away the middle turn lane to give space for a protected bike lane. But, we propose to keep the turn lane at the intersections of Brommer Street and Capitola Road. In addition, we recommend narrowing the driving lanes to give more space for the protected bike lane. The NACTO Urban Design Guidelines has shown that narrower driving lanes have a positive impact on a street's safety by discouraging speeding.[6] We also recommend moving back stop lines at the Brommer Street intersection to add a protected intersection. In regards to the Capitola Road intersection, we recommend implementing a two-way bike lane to connect with the school. The graphic below shows NACTO's suggested design of a protected intersection.

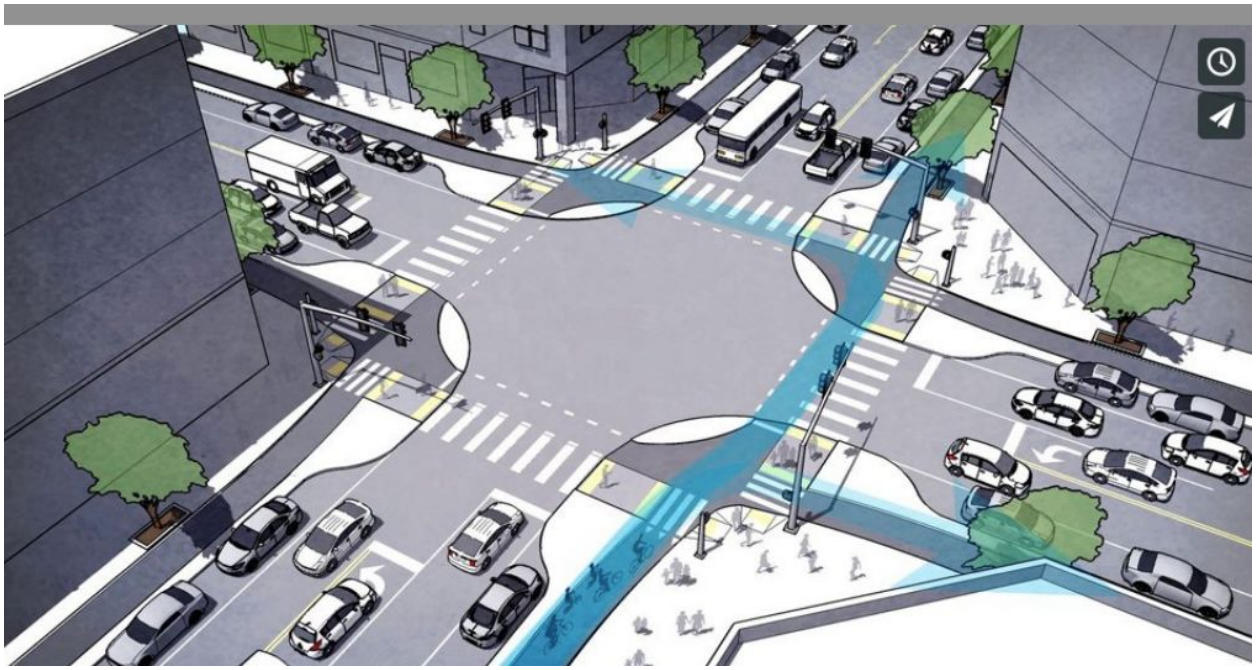

Figure 13. NACTO design guidelines for a protected intersection

[6] NACTO's Urban Bikeway Design Guide has more details about our recommendations in regards to appropriate street widths, bike lanes, intersections, driveways, and street safety. These details can be found at https://nacto.org/publication/urban-bikeway-design-guide/

Design Guidelines and Recommendations

NACTO's Urban Bikeway Design Guidelines provides helpful standards and recommendations that we are referencing in providing our suggestions for the 17th Avenue project.

- **Driving lane widths:**
    - For cities, NACTO provides a standard lane width of 10 feet and a standard of 9 feet for turning lanes. The smaller lane widths are appropriate for urban areas and have a positive impact on street safety by encouraging drivers to slow down.
- **Protected bike lanes and one-way protected cycle tracks:**
    - Bicycle lanes can be accommodated into already existing infrastructure by decreasing the space given to driving lanes and adding a physical barrier between motorists and cyclists. In general, bike lanes must be a minimum of 5 feet in width, however, NACTO's requirements vary depending on the type of street. For example, when a bike lane runs next to a curb the recommendation is 6 feet, and 7 feet when traveling uphill. These extra feet are meant for cyclists to be able to safely pass each other when traveling at different speeds.

Figure 14. A car protected bike lane with additional protection from bollards. Source: https://nacto.org/publication/urban-bikeway-design-guide/cycle-tracks/one-way-protected-cycle-tracks/

- **Bike boxes:**
    - Bike boxes are a simple and cost effective way to provide a safe option for cyclists to turn left at intersections. This is done by creating a painted space next to a crosswalk in which only bicycles are allowed to wait in during stops. Bike boxes provide many benefits, including increasing cyclist visibility, provide a quick way to exit an intersection, and ease the stress of making left turns off major roads.

Figure 15. A bike box design in Tuscan, Arizona. Source: https://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/bike-boxes/

- **Raised crosswalk or driveway:**
    - Raised crosswalks are a way to control motorist's speed and provide safe intersections for both pedestrians and cyclists. These must have warning signs for drivers and pedestrians, and must have the NACTO guide's recommended heights and slopes. Slopes should not exceed 1:10 or be less steep than 1:25. Side slopes on tapers should be no greater than 1:6. The vertical lip should be no more than a quarter-inch high.[7]

[7] NACTO. Urban Street Design Guide

Figure 16. A raised crosswalk. Source:
https://www.sfmta.com/blog/neighborways-new-type-project-create-calmer-more-livable-streets

- **Protected intersections:**
    - Protected intersections provide safety by adding physical corner islands to intersections and forcing cars to slow down in order to make sharp, rather than rolling right turns. In addition, these intersections provide no space to make right turns into bike lanes and helps prevent cars from driving into the bike lane at the turn.

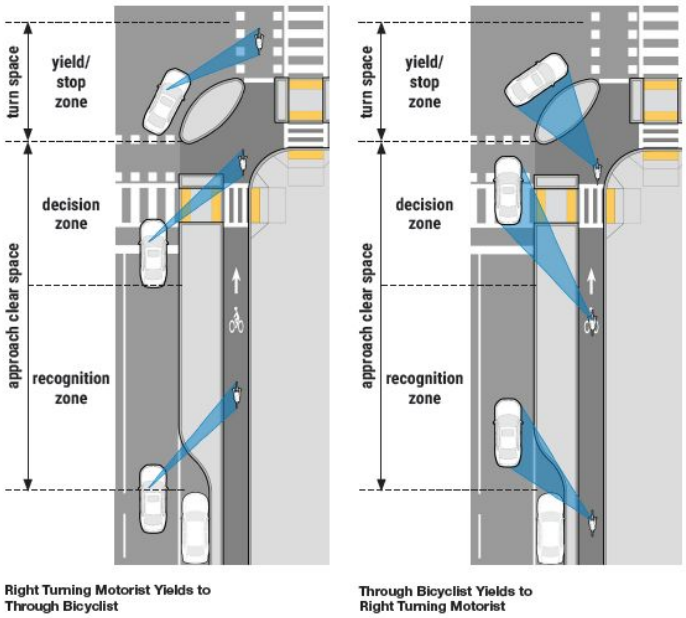

Figure 17. Close-up of the corner safety islands design & zones

Programmatic Recommendations

Turn Lane

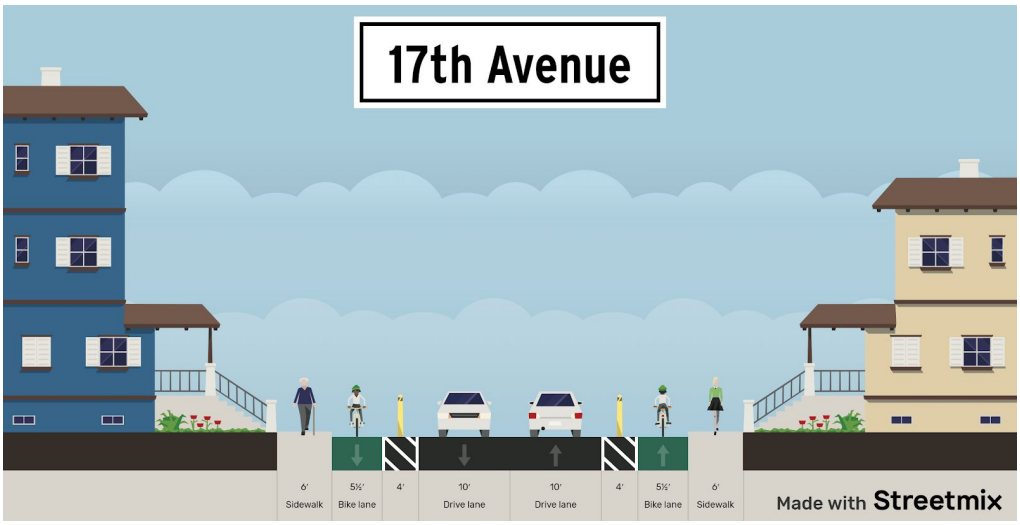

Figure 18. Proposed street design without a turn lane

The NACTO design guide states that protected bike lanes should be a minimum of 5 feet with a 3 foot buffer on each side. An 8 foot total bike lane can be accomplished with the deletion of the turn lane. Observation of the road showed few vehicles utilizing the turn lane, and we believe this would not negatively impact traffic— rather, eliminating the turn lane forces traffic to slow down and motorists to maintain a safe speed. In addition, figure 18 shows our proposal that the car lanes be narrowed from 10 feet and 9 inches to just 10 feet, to give space for a larger buffer. The NACTO design guide states that lane widths of 10 feet are appropriate in urban areas and have a positive impact on a street's safety. We are proposing to install a total of 5 ½ feet for the bike lane including a 4 foot buffer and 10 foot vehicle lanes (Figure 18).

17th Avenue and Brommer Street Intersection

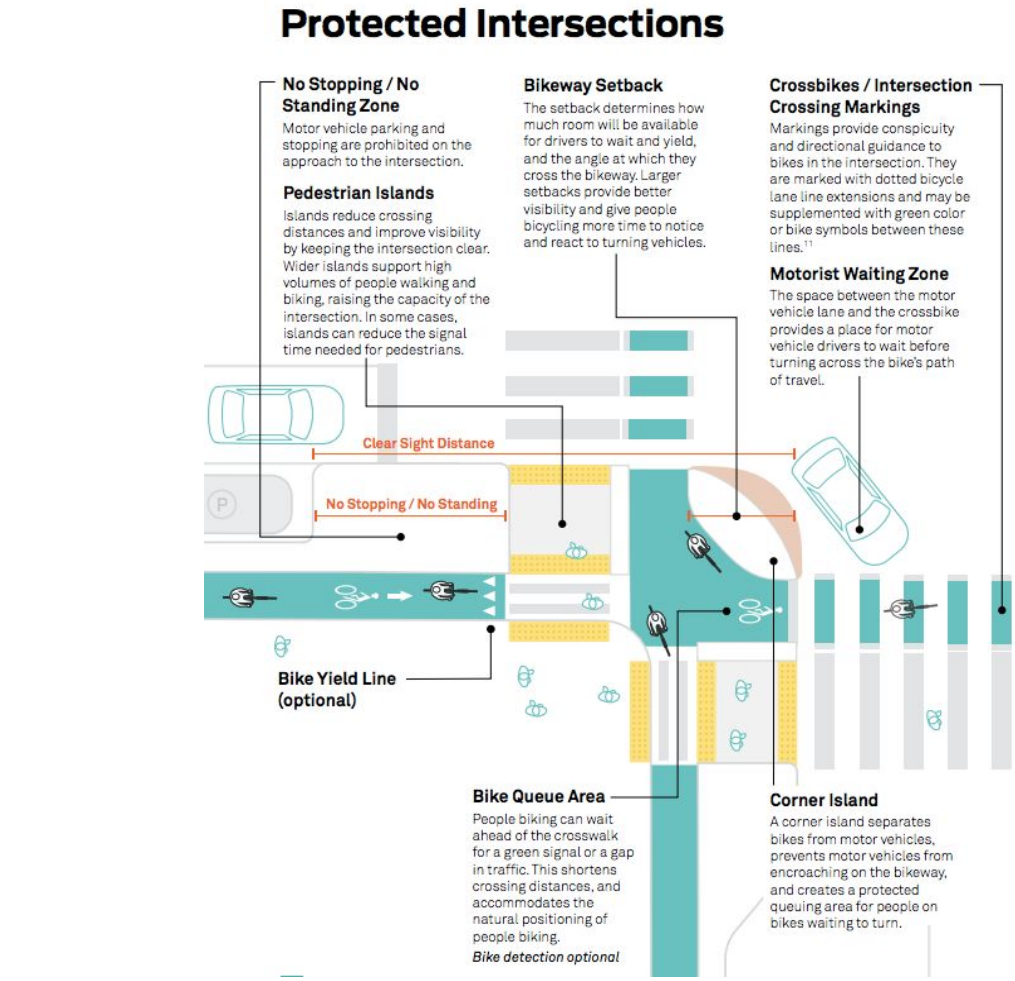

Figure 20. Details of the protected intersection. Source: https://nacto.org/publication/urban-bikeway-design-guide/

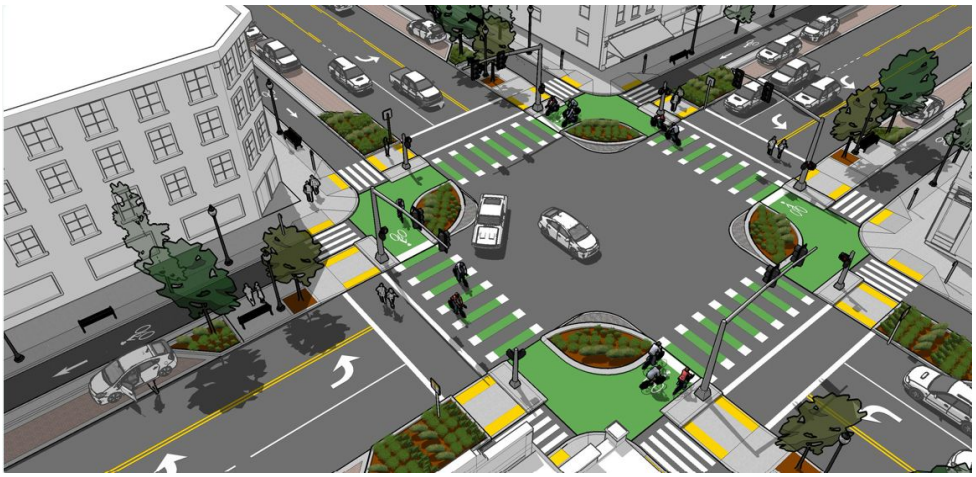

Figure 21. Example of what a proposed intersection at Brommer Street and 17th Avenue might look like. Source: NACTO

Figure 22. Aerial view of the current intersection at 17th Ave. and Brommer St. with the current dimensions

We are proposing a protected intersection at 17th Avenue and Brommer Street. Protected intersections keep bikes separate from motor vehicles up until the intersection, which greatly reduce crossing distances, improve sightlines, and result in dramatically safer streets where they are installed.[8] Figure 20 shows some of the aspects we recommend for the 17th Avenue and Brommer intersection. We propose to include setback crossings, pedestrian islands, corner safety islands, forward stop bars for cyclists, and "yield to pedestrians" signs. This will shorten the crosswalk distance and provide more protection to cyclists and pedestrians at the intersection. The main feature of the protected intersection are the bulbed corners. The bulbed corners slow automobiles and give drivers more time to see cyclists coming. Figure 21 shows how adding additional protection to the intersection, as suggested by NACTO standards, creates a barrier between cars and bicyclists and adds a layer of protection, especially in circumstances of right-turning cars.

[8] NACTO Designing Cities Conference 2015
https://nacto.org/wp-content/uploads/2015/07/Nick-Falbo-Alta-P-D_Protected-Intersection.pdf

However, space is not permitted and therefore the sidewalk may need to be redesigned for the protected intersection at 17th Avenue and Brommer Street. With the current dimensions (Figure 22), a protected intersection is not feasible. If we were to push the crosswalks and stop lines back to accommodate the bulbed corners, the lane widths will be too small and will not support the NACTO recommended guidelines. In addition, with a 5 ½ foot bike lane and a 3 foot buffered protection, there will not be enough space for appropriate driving and turn lanes. As a long-term project, we recommend creating a protected intersection at 17th Avenue and Brommer Street if the corner parcels are re-developed. An ideal lane width will be 43 feet for the streets at the intersection. This will include a 4 foot bike lane and 3 foot buffers for both sides of the street, 10 foot driving lanes, and a 9 foot turning lane.

Proposed bike lane extension

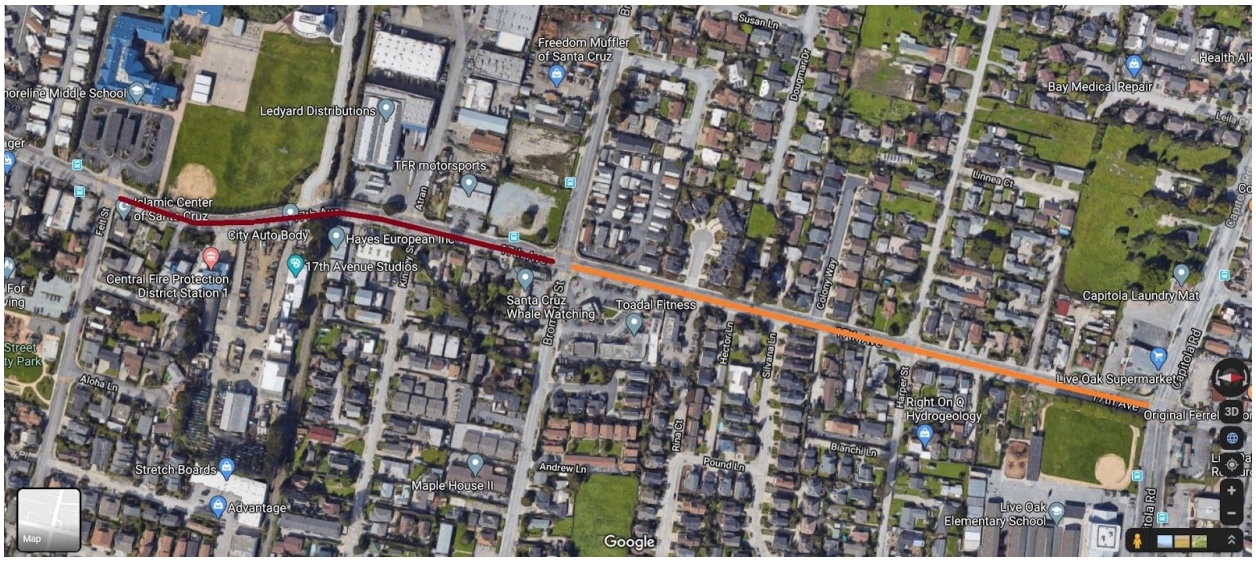

Figure 23. Extension of protected bike lane along 17th Avenue up to Capitola Road

Bike Santa Cruz County is putting up a pop-up protected bike lane in May from Felt Street to Brommer Street. Their pop-up is only temporary and will include a bike lane of a total of 6 feet 10 inches, including a 2 foot buffer for the entire length of the project (Brommer Street to Felt Street), 10 foot vehicle lanes, and a 9 foot and 6 inch center turn lane. Figure 23 shows our proposal to extend and make the protected bike lane permanent, based on the success of the pop-up by Bike Santa Cruz County. We propose to extend the protected bike lane beyond the

intersection of 17th and Brommer up through Capitola Road. In doing so, this protected bike lane will encompass a busy intersection, and provide additional protection for attendees of the Live Oak Elementary School and nearby businesses. Ultimately, this extension will allow more students at Live Oak Elementary School to safely bike to school.

Two Way Bike lane

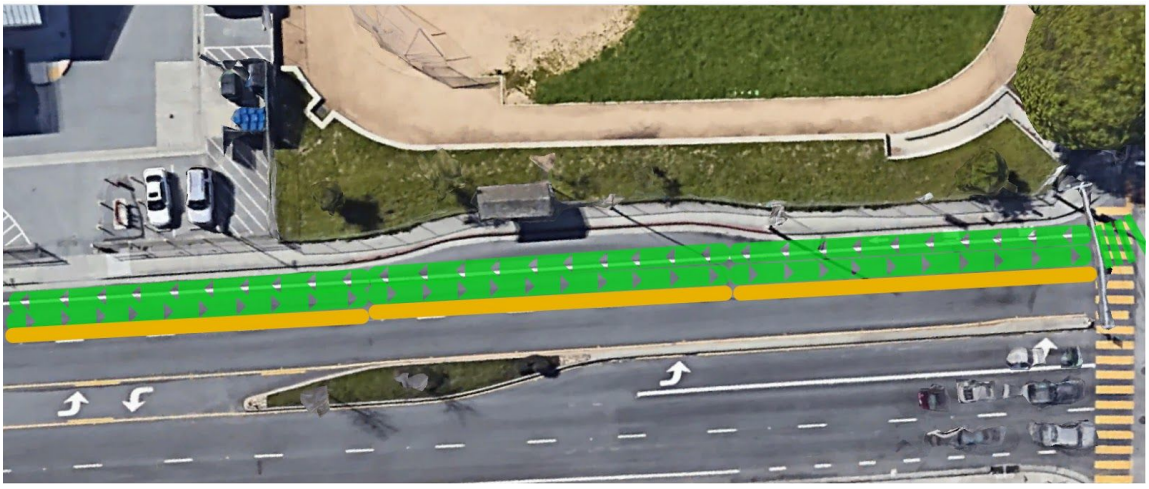

Figure 24. Proposed two way bike lane and buffer on East Capitola Road

Figure 25. Two way bike lane along Capitola Road showing the connection from Capitola Road to 17th Avenue and highlighting the close-up image from figure 24 (red box).

To further protect student and youth cyclists, we propose to implement a two way protected bike lane on East Capitola road up to the entrance of Live Oak Elementary on Chanticleer Avenue. This will allow students to travel to and from 17th Avenue and Live Oak Elementary School safely, and avoid an unprotected left turn at the busy Capitola Road and 17th Avenue intersection (Figure 25). NACTO, recommends that two way bike lanes be protected by a 3 foot buffer with 8 to 12 feet designated for the bike lanes themselves. In order to achieve this, we recommend eliminating one of the two 10 foot car lanes to allow for a 3 foot buffer and two 6 feet bike lanes. The ADT on Capitola road is between 10,000 and 11,000, so the removal of a single turn will not impact traffic stress by a significant amount.[9] Figure 24 shows this proposal and how the outer lane can be eliminated to provide enough space for two bike lanes and a buffer. If Santa Cruz does not deem this plausible, we recommend creating the bike lane on school property by pushing the school fence back 3 feet and using the grass and sidewalk space.

[9] Average Daily Traffic Count at 17th Ave and Capitola Rd from Santa Cruz County at https://sccrtc.org/wp-content/uploads/2011/07/2011-06-adt-counts.pdf

Raised crosswalks

Figure 26. Proposed raised crosswalk on 17th Avenue and Odyssey Ct. intersection

The section of 17th Ave between Brommer and Capitola Road features six residential side streets. Cars travelling on 17th Ave use the median turn lane to access these streets. These side roads present a safety hazard to cyclists as cars pull out onto 17th Avenue using the bike lane. Careless drivers may not look for oncoming cyclists. Figure 26 shows a proposal for the implementation of raised crosswalks at each of these side streets to further protect cyclists, particularly children commuting to Live Oak Elementary. The combination of protected bike lanes and raised crosswalks encourage turning cars to stop completely before entering or exiting 17th Avenue.