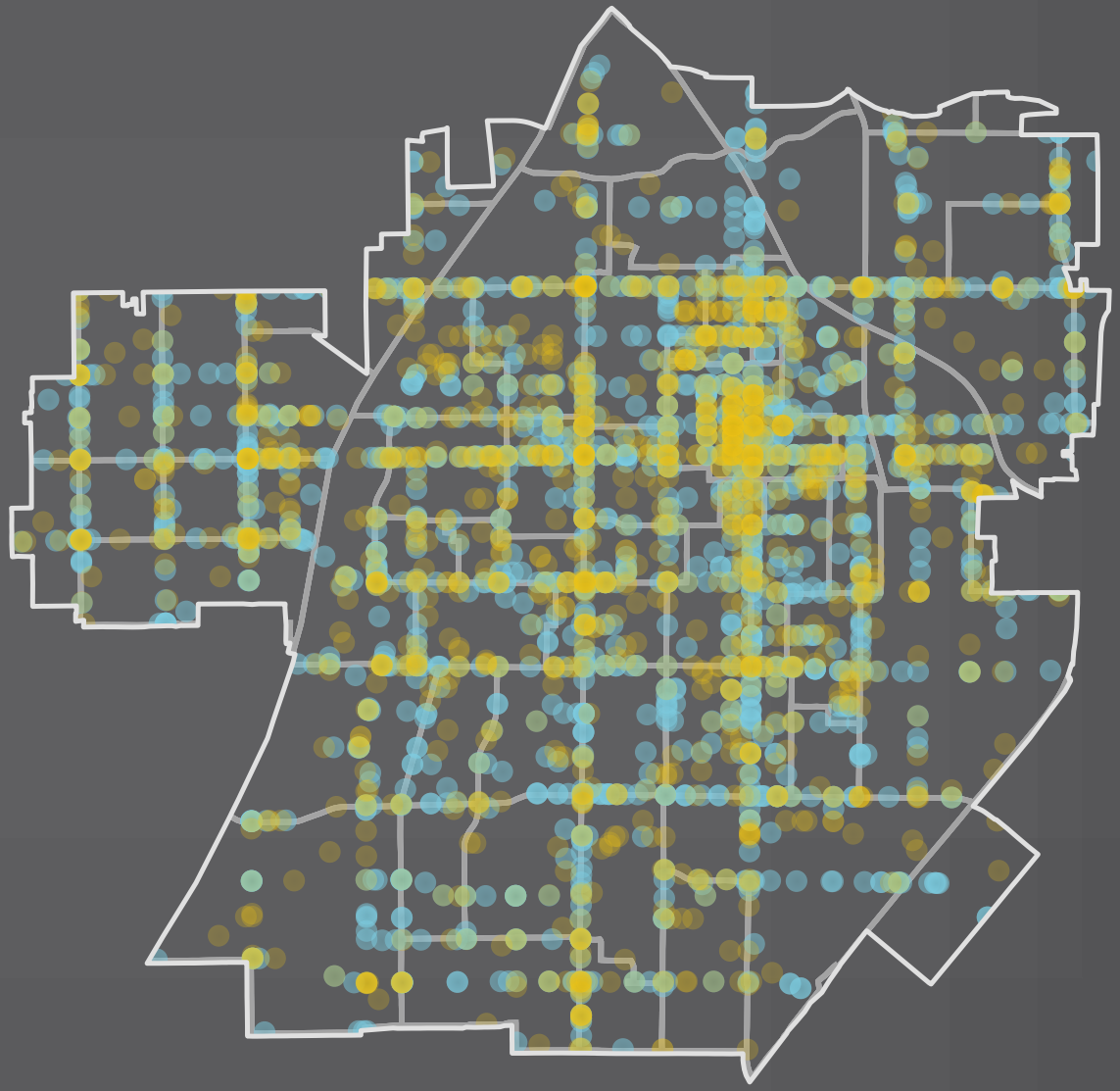
SAFE MOBILITY SANTA ANA PLAN

2016



ACKNOWLEDGEMENTS

The City of Santa Ana appreciates the time, energy and commitment of staff, stakeholders and community members who participated throughout the planning process. Special thanks to the following individuals and organizations who made significant contributions.

Santa Ana City Council

- Miguel A. Pulido, Mayor
- Vicente F. Sarmiento, Mayor Pro Tem - Ward 1
- Michele Martinez, Councilmember - Ward 2
- Angelica Amezcua, Councilmember - Ward 3
- P. David Benavides, Councilmember - Ward 4
- Roman Reyna, Councilmember - Ward 5
- Sal Tinajero, Councilmember - Ward 6

City of Santa Ana City Manager's Office

- David Cavazos, City Manager
- Alma Flores, Communications Manager

City of Santa Ana Public Works

- Fred Mousavipour, Executive Director
- Edwin "William" Galvez, City Engineer
- Taig Higgins, Principal Civil Engineer
- Zdenek Kekula, Senior Civil Engineer
- Cory Wilkerson, Active Transportation Coordinator

City of Santa Ana Planning and Building

- Hassan Haghani, Executive Director
- Melanie McCann, Senior Planner

Santa Ana Police Department

- Carlos Rojas, Chief of Police
- Enrique Esparza, Commander
- Ruben Ibarra, Commander
- Matthew Wharton, Corporal

Stakeholder Organizations

- Santa Ana Active Streets
- Orange County Health Care Agency
- Santa Ana Environmental & Transportation Advisory Committee
- Santa Ana Planning Commission

Consultant Team

- Dru van Hengel, Nelson\Nygaard
- Mathew Berkow, Nelson\Nygaard
- Drew Meisel, Nelson\Nygaard
- Jeff Heald, DKS Associates

CONTENTS

This plan was undertaken to take back the streets for our community. It will help realize our 2015 commitment to support the USDoT's "Safer People, Safer Streets: Pedestrian and Bicycle Safety Initiative."

EXECUTIVE SUMMARY

Santa Ana rejects severe and fatal injuries as a necessary by-product of using our streets.

For almost twenty years, Santa Ana has addressed serious and fatal traffic collisions with education and enforcement strategies to support safer walking and bicycling along and across our city streets. Despite past and current efforts, vulnerable roadway user collisions are not going down. In fact, bicycle collisions are on a long term upward trend, because ridership has increased while on–street bikeways remain uncommon. Because more than half of our residents don't have access to their own personal vehicles, we are much more reliant on walking, bicycling, and public transit than other cities in the region. Normal activities such as going to school, visiting places of worship, and conducting business are challenging because our roadway network, was built to support large numbers of personal vehicles traveling through the city. Wide street designs with long distances between intersections that favor through traffic and speed at the expense of safety are no longer supportable. Transportation safety is a social issue impacting individuals and families throughout the community. Within Santa Ana, there are more collisions in places with higher proportions of low income households lower education levels, youth, and Hispanic/Latino residents. This plan recognizes that people should not face additional hazards when traveling simply because they cannot afford to drive or are not old enough to do so. This plan was undertaken to take back the streets for our community and will help realize our 2015 commitment to support the USDoT's "Safer People, Safer Streets: Pedestrian and Bicycle Safety Initiative."

GOALS AND OBJECTIVES

The ***goals*** of Safe Mobility Santa Ana are:

» Substantially increase safe mobility in all areas of the City

» Achieve zero fatal bicycle/pedestrian collisions

» Reduce vehicle speeds

» Minimize demonstrated collision patterns

Its ***objectives*** include:

» Reduce collisions citywide, while focusing capital investments at high collision locations

» Recommend solutions to evolve the roadway network into one where people can make transportation decisions and unanticipated mistakes without risk of severe injury or death

» Reject severe and fatal injuries as a necessary by-product of multimodal transportation

» Prioritize traffic safety over congestion management, accepting that improving safety for all roadway users will in some cases result in unavoidable delay

» Suggest infrastructure improvements that reduce speeds and separate vulnerable roadway users from moving traffic

» Provide a balance of engineering, education and enforcement solutions to shift toward a safety culture

ALIGNMENT WITH OTHER PLANS

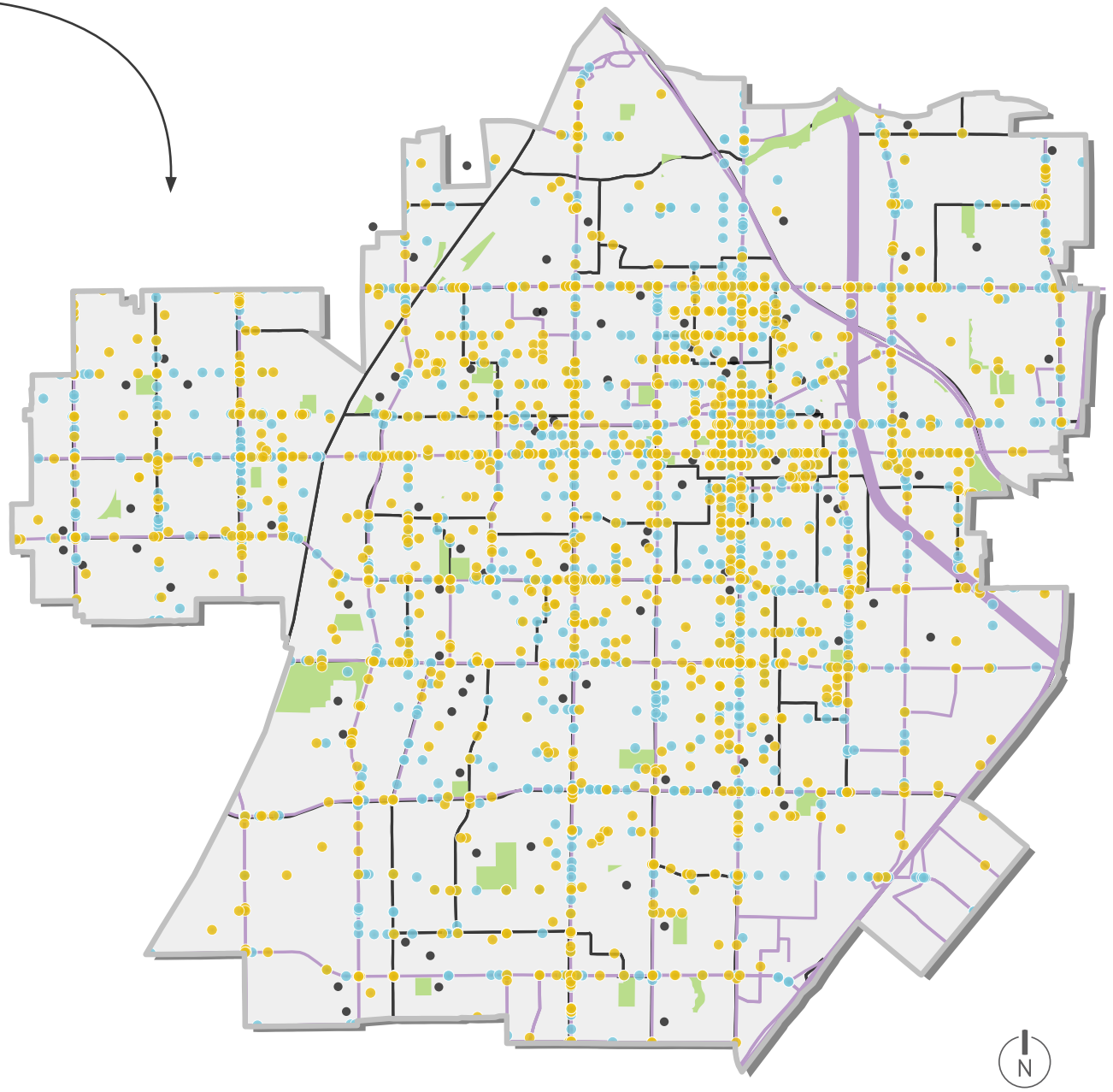
This plan's goals and objectives are aligned with and shared by other city plans and work efforts. The plan aligns with the city's Strategic Plan, particularly Goal #5, Community Health, Livability, Engagement & Sustainability. It provides concrete steps to incorporate the improvement of walking and biking lanes into the Circulation Element of the City's General Plan. It is also in alignment with the City's strategies to improve community safety by modernizing the community policing philosophy to improve customer service, crime prevention and traffic, pedestrian, and bicycle safety. It provides strategies to support the Police Department, Public Works Agency and the Santa Ana Unified School District Task Force on community outreach and traffic safety.

Stakeholders and community survey respondents are concerned about transportation justice and safety in Santa Ana

THE APPROACH

Safe Mobility Santa Ana responds to persistent transportation safety problems that impact all residents. The plan uses a detailed collision analysis to identify specific hot spot locations and citywide collision trends. Local and specific safety problems are linked with appropriate solutions to create a safe network of roadways, educational campaigns, and enforcement strategies so people can make transportation decisions and unanticipated mistakes without risk of severe injury or death.

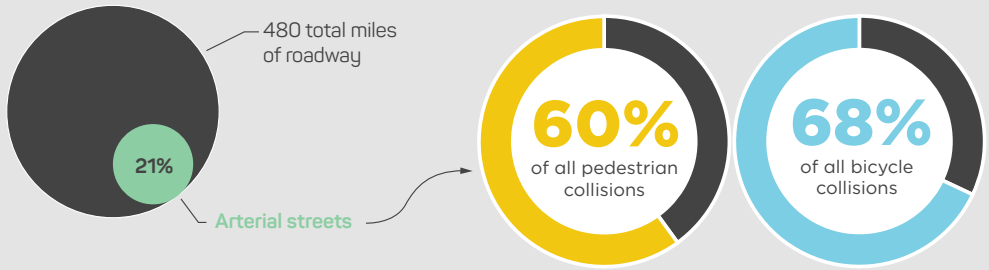
COLLISIONS AND KEY DESTINATIONS



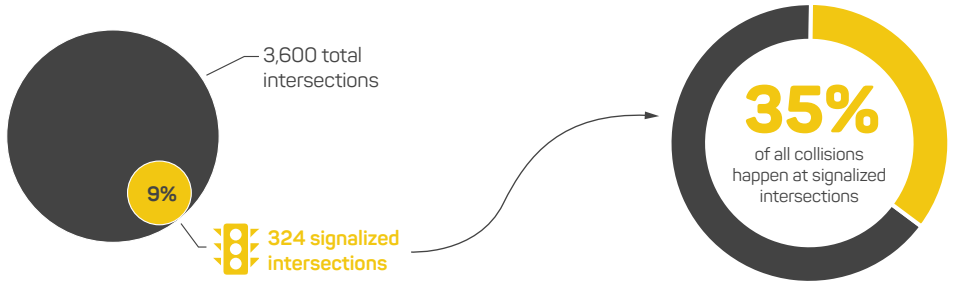
KEY ANALYSIS FINDINGS

In Santa Ana, larger roadways, larger intersections, streets with long distances between traffic signals, and roadways with higher speeds are associated with increased frequency and severity of collisions.

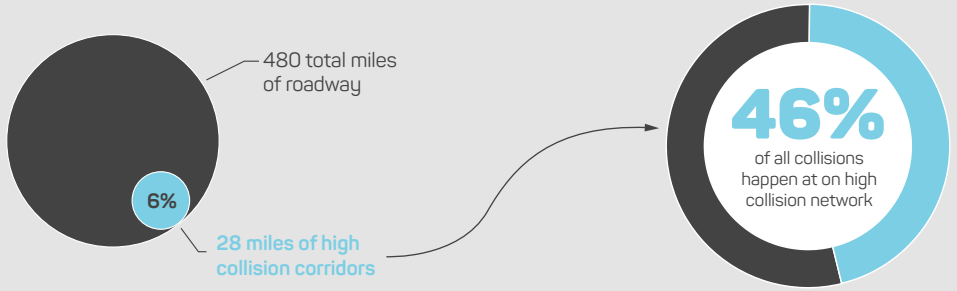
» **Arterial streets** constitute only 20% of our roadway network, but 60% of all pedestrian involved collisions and 68% of the collisions involving people on bicycles occur on them.



» **Traffic signals** are not preventing pedestrian and bicycle involved collisions at our larger intersections. More than 1/3 of all collisions occur at traffic signals despite only 9% of the city's intersections being signalized.



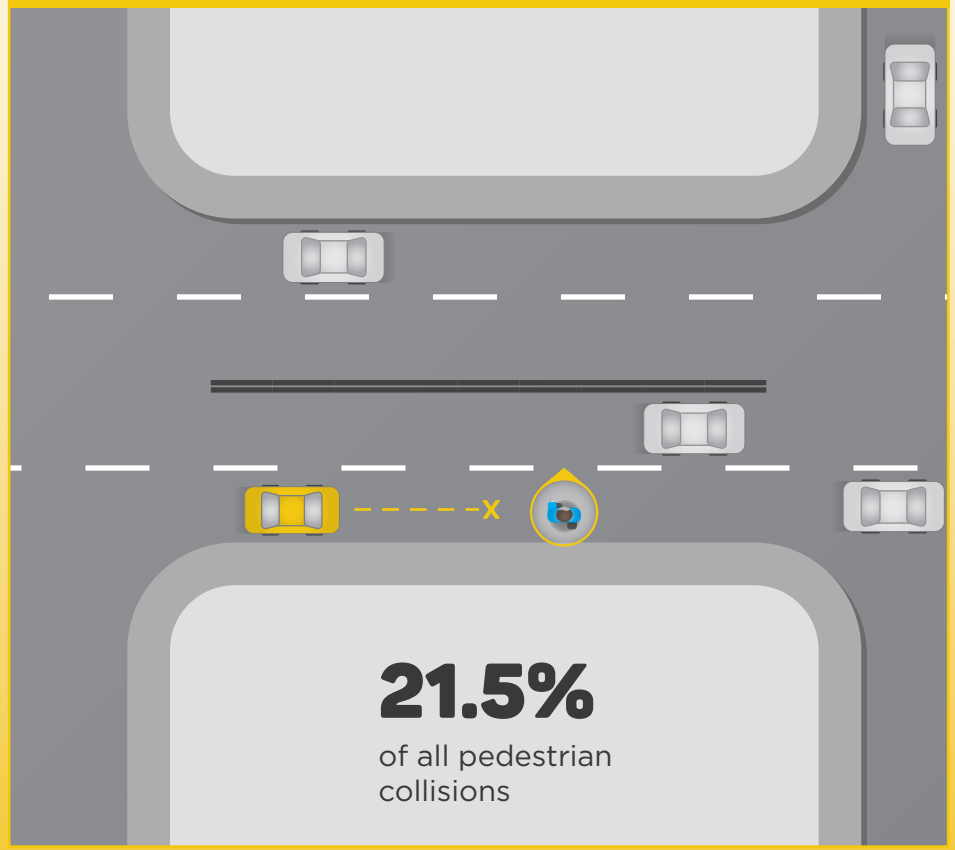
» **Nearly half** of all collisions (46%) involving people walking or bicycling occur on just 6% of our roadway miles. These high collision corridors are where we will focus first.



TOP PEDESTRIAN COLLISION TYPES

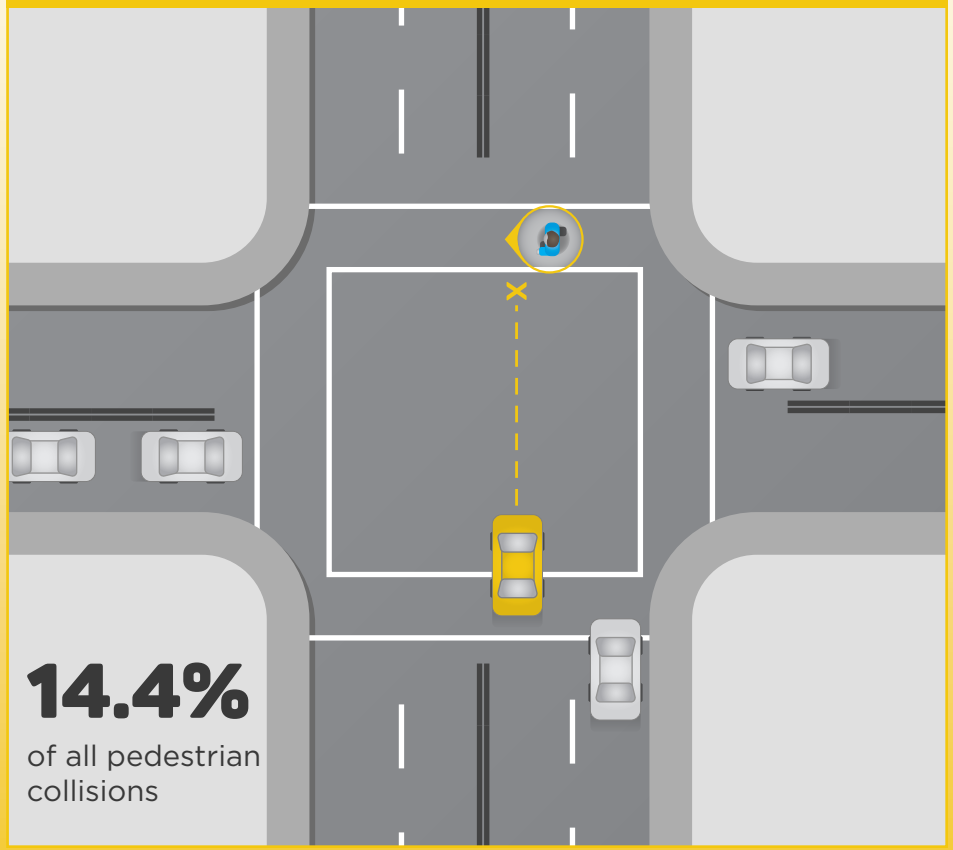
Pedestrian collisions are most common on larger roadways. The top two collision types involve people attempting to cross mid-block and at unsignalized intersections (where they legally have the right of way). Collisions involving straight, right turning and left turning vehicles at signalized intersections account for 35% of pedestrian collisions.

Through Vehicle at Mid-Block Location



21.5%
of all pedestrian collisions

Through Vehicle at Unsignalized Intersection

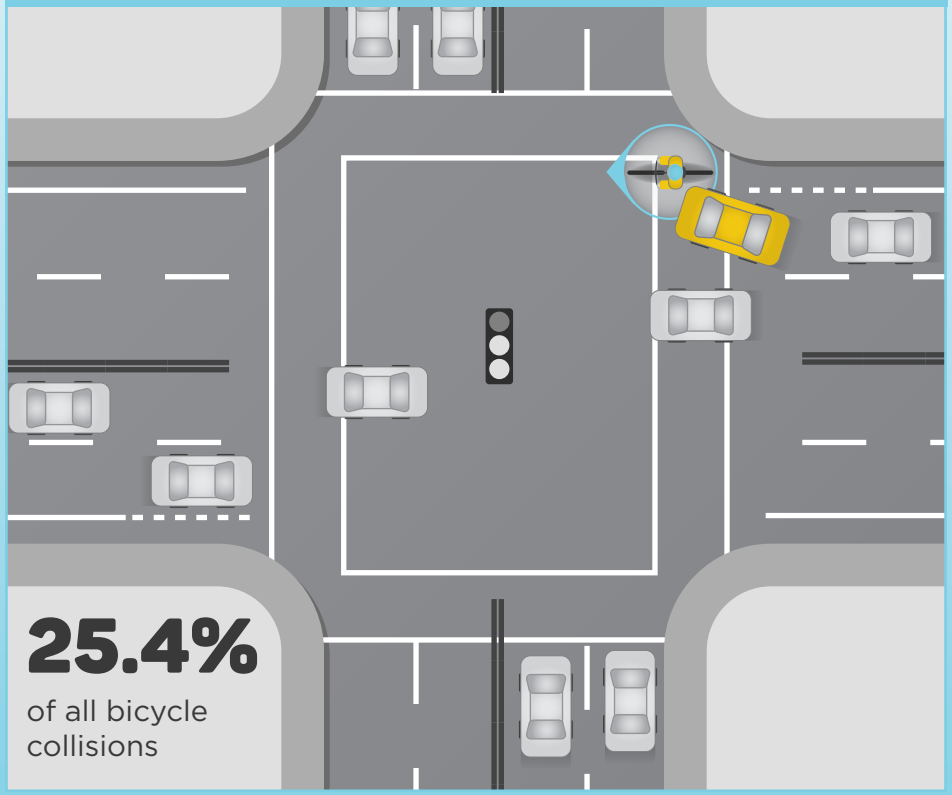


14.4%
of all pedestrian collisions

TOP BICYCLE COLLISION TYPES

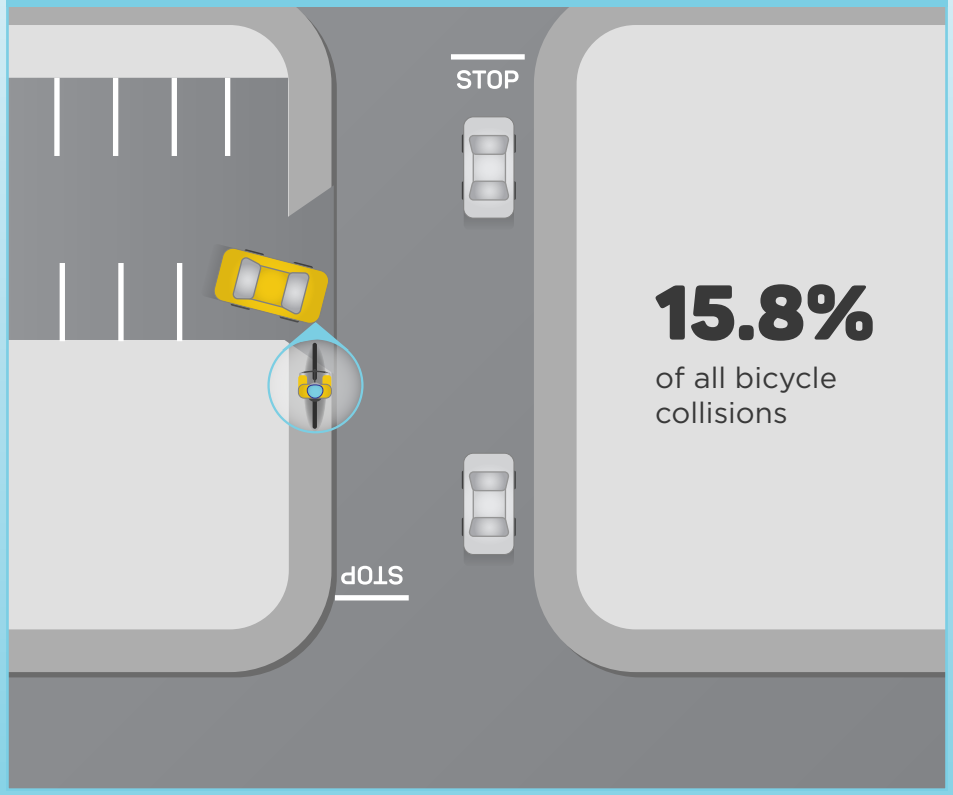
Our roadway system has kept up with the demand for personal vehicles, but not with the increasing activity of people on bicycles. People riding on and off sidewalks are symptoms of on-street bicycling conditions that feel unsafe due to lack of separation from fast moving traffic.. This situation makes it difficult for drivers to predict where and when they will encounter bicycles. The top two bicycle collision types in Santa Ana are illustrated below. The top two bicycle collision types involve a driver making a “right-hook” or entering traffic from a driveway.

Motorist turned or merged right into path of bicycle



25.4%
of all bicycle collisions

Motorist drove out mid-block

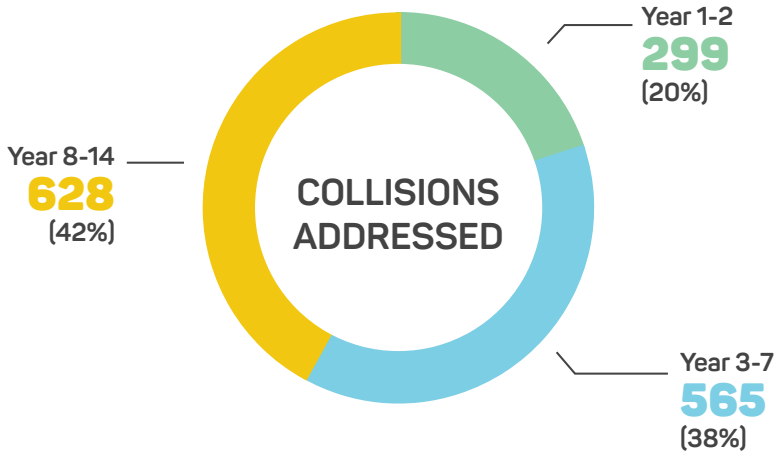


15.8%
of all bicycle collisions

MOVING FORWARD

Large intersections and big streets aren't supporting what matters most – the safety and mobility of residents and visitors as they patronize community destinations. This plan addresses that by recommending roadway improvements for the highest collision corridors and intersections. Suggested roadway improvements range from signal modifications and lane narrowings to capital improvement projects such as road buffets.

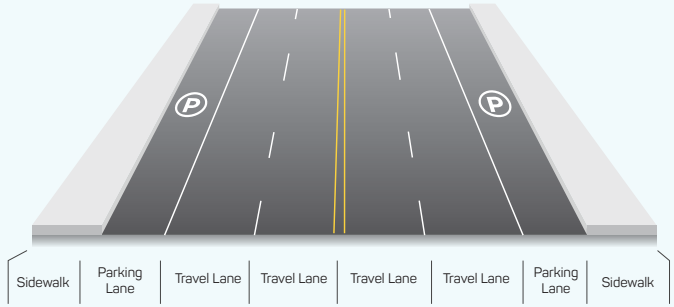
It includes a comprehensive approach including engineering, education and enforcement solutions to be implemented during the next 15 years. The total cost is estimated at nearly $57 million, including $42 million of infrastructure projects that will be funded through regional, state, and federal grant programs. Non-infrastructure costs cover funding for school based education and additional enforcement.



WHAT IS A ROAD BUFFET?

The Safe Mobility Plan uses the term 'road buffet' - rather than the more commonly used 'road diet' - to describe the re-allocation of roadway space. While road diet implies something being taken away, the road buffets recommended in this plan will result in a greater variety of attractive transportation choices to serve the needs of Santa Ana residents.

STANDARD ROADWAY



WITH ROAD BUFFET TREATMENT

ENGINEERING

Many of the high collision corridors involve long term engineering solutions that result in road buffets. Excess vehicle lanes will be repurposed to increase safety of walking, bicycling and using transit. The city will also use existing and future grant funding to provide a variety of attractive, separated and convenient options for people using all our valued modes. Other solutions include:
Protected bike lanes – provide an attractive and safe bicycle facility for people with a range of riding abilities using physical separation from motor vehicle traffic such as on street parking, curb, other delineators, or landscaping.
Median pedestrian and bicycle refuge islands - make roadway crossings easier and safer by limiting exposure to through moving vehicles, enabling crossings to commence when there are gaps in traffic from one direction at a time; and providing a safe stopping place in the middle of the roadway for pedestrians who are not able to make the complete street crossing at one time.

EDUCATION

A variety of messages and media that increase awareness of behaviors that cause collisions will help the community shift toward a traffic safety culture. Our volunteers and staff will continue to do school outreach and education, using already available safety campaigns such as Travel Safe, Share the Space and other messages provided by the Orange County Transportation Authority (OCTA) and the National Highway Traffic Safety Association. At the same time, we will look for funds to develop customized messages specific to Santa Ana for use in paid advertising. We will start with low cost high impact strategies.

ENFORCEMENT

Responding to the large number of collisions in Santa Ana leaves insufficient time for enforcement. Police need more time for proactive enforcement to discourage unsafe behaviors rather than simply reacting to collisions and completing collision reports. The plan recommends phasing in civilians to do collision reporting and more sworn officers starting in Year 3. In total the plan recommends funding twelve new FTEs above 2016 levels by Year 6. Changes to collision reporting and data storage practices will be made to accurately monitor collision trends involving sidewalk riding and crossing behavior.

[this page intentionally blank]


The safety of people who walk, use transit, or ride bicycles on Santa Ana roadways is of the utmost importance.

1 INTRODUCTION

Santa Ana residents travel in a variety of ways, including on foot, bicycle, public transportation and motor vehicles.

They are much more reliant on walking, bicycling, and public transportation as compared to residents in Orange County and the State of California. Nearly 55% of Santa Ana residents do not have access to a personal vehicle, as compared to 37% for Orange County (American Community Survey 2009-2013).

Some of Santa Ana's larger streets lack comfortable and separated places for residents to walk across and bicycle along. Pedestrians are more than 20 times as likely as motorists to sustain a severe or fatal injury in the event of a collision. While less than 1% of motorists sustain a severe or fatal injury when involved in a collision, 18% of pedestrian collisions and 4.4% of bicycle collisions in Santa Ana result in a severe or fatal injury.

Previous safety initiatives have not lowered the number of annual pedestrian collisions, which have been relatively constant over time. Bicycle collisions are on a long-term upward trend; the number of annual bicycle collisions increased every year from 2006 to 2013. There are now more annual reported bicycle collisions than reported pedestrian collisions. Additional bicycle infrastructure is needed to create a connected network to support this mode of travel, which appears to be on the rise.

The Safe Mobility Santa Ana plan takes a new approach to addressing these trends. The plan utilizes a detailed collision analysis to identify specific hot spot locations, citywide trends, and best practices in traffic safety to identify solutions that will evolve the roadway network in Santa Ana into one where roadway users can make transportation decisions and unanticipated mistakes without risk of severe injury or death. The recommendations of this plan recognize the need to balance the many objectives of the local transport system, including travel time reliability, safety, and meeting the mobility needs of a variety of roadway users, including personal and freight vehicles on regionally significant streets.

In developing and implementing this plan, Santa Ana joins an emerging nationwide trend where cities are increasingly deciding to reject severe and fatal injuries as a necessary byproduct of multimodal transportation.

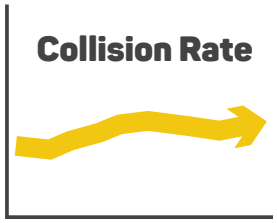
SANTA ANA BY THE NUMBERS

Pedestrians are

20x

more likely to sustain a severe or fatal injury when involved in a collision than motorists

Bicycle collisions are on a long-term upward trend



Previous safety initiatives have not lowered pedestrian collision rates

55%

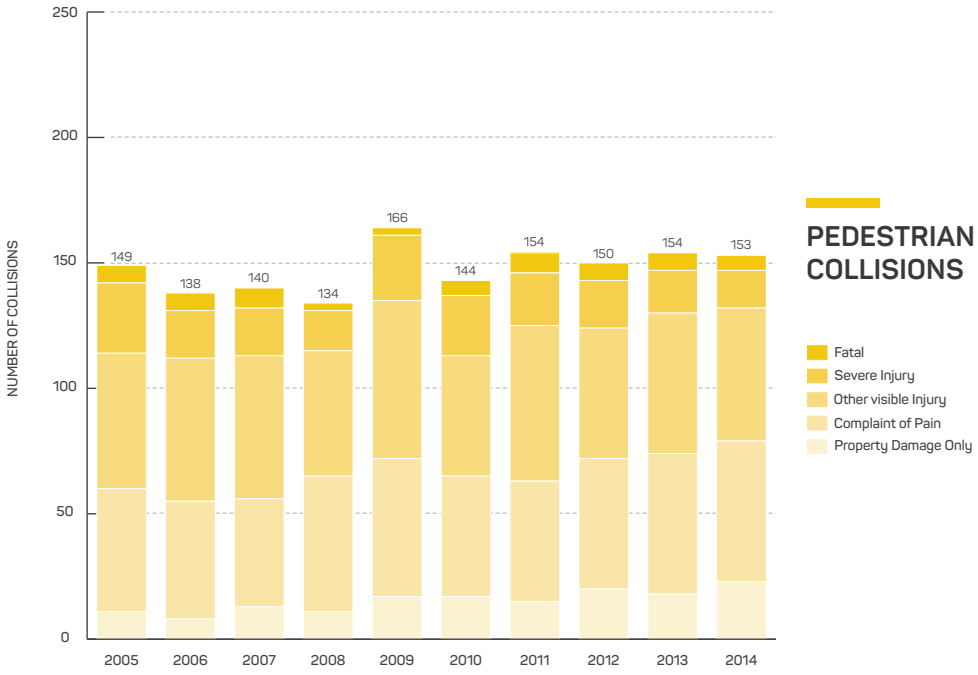
of Santa Ana residents do not have access to a personal vehicle

PEDESTRIAN TRENDS

150 REPORTED COLLISIONS PER YEAR

6 AVERAGE ANNUAL FATALITIES

17.9% SHARE OF REPORTED COLLISIONS RESULTING IN SEVERE OR FATAL INJURY

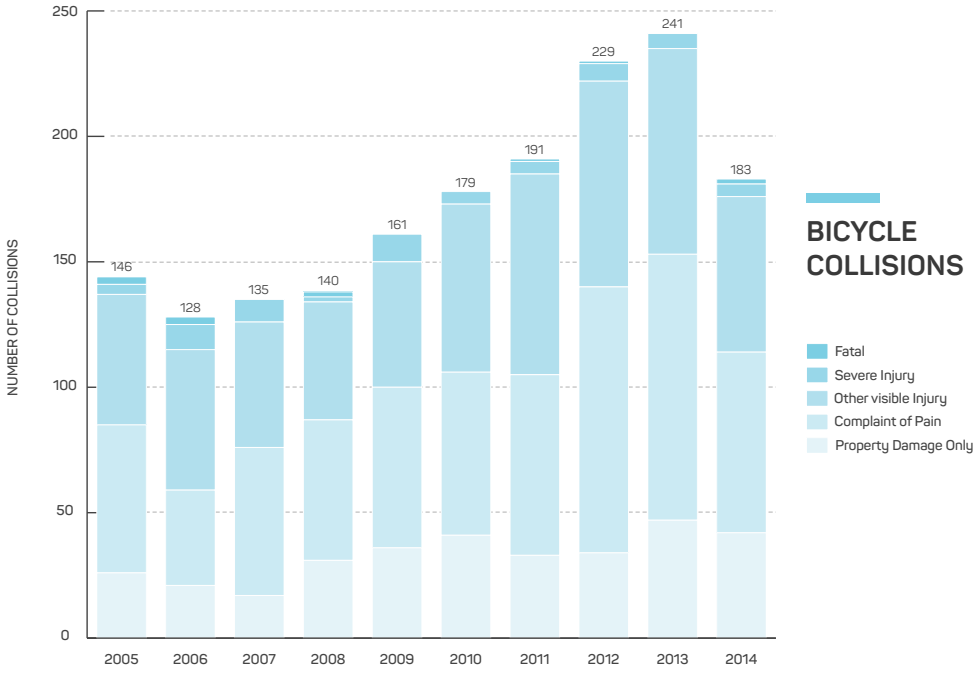


BICYCLIST TRENDS

175 REPORTED COLLISIONS PER YEAR

2 AVERAGE ANNUAL FATALITIES

4.4% SHARE OF REPORTED COLLISIONS RESULTING IN SEVERE OR FATAL INJURY



Relationship of this Document to Existing Documents

Santa Ana has tried a variety of strategies over the years to reduce the number of vulnerable roadways users injured in collisions. Despite this, the number of cyclists and pedestrians injured or killed in traffic collisions remains unacceptably high. The Santa Ana City Council and community are now calling for a change to the City's mobility priorities.

This plan will be a resource for both long term planning and daily operations. The cut sheets and priority project locations should inform a changing roadway landscape through capital project delivery and development review. The policy and maintenance recommendations will inform planning and traffic operations decisions. And finally, the enforcement and education recommendations will support dedication of more resources for community awareness and shared responsibility towards a safer Santa Ana.

SANTA ANA PLANS

This plan is the highest priority for the City of Santa Ana Public Works Agency. It provides recommendations to prioritize traffic safety over congestion management. Improving safety for all roadway users will in some cases result in unavoidable delay.

The infrastructure and non-infrastructure actions will be incorporated into the City's General Plan Circulation Element.

The **Circulation Element Update** will communicate goals, policies, and programs to address Santa Ana's local and regional transportation needs in a complete streets framework.

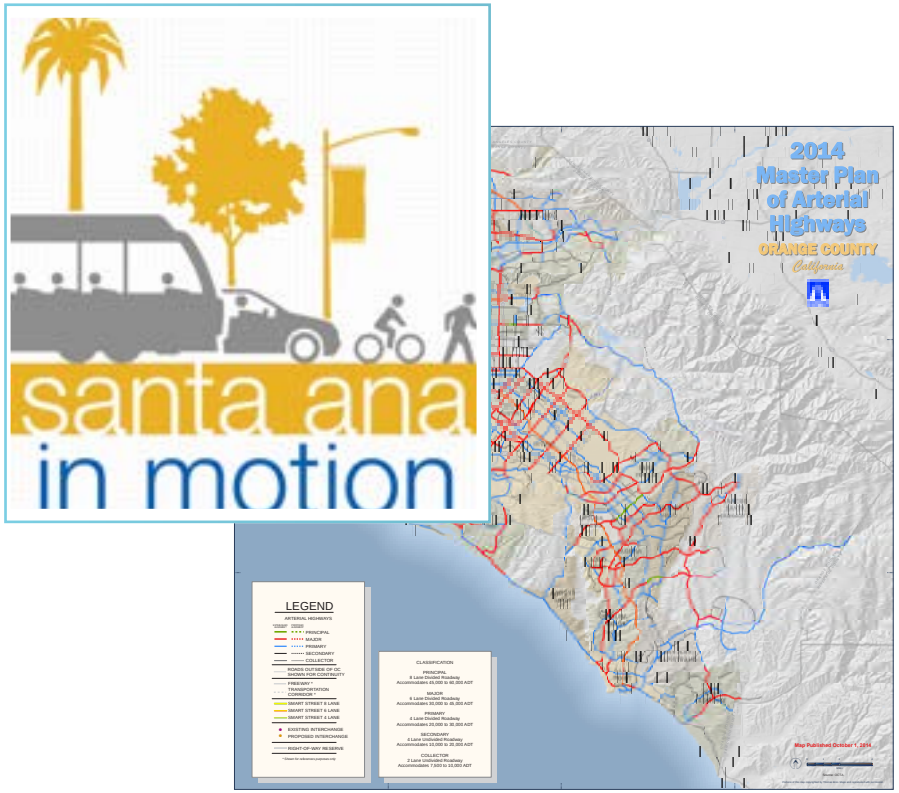
The **Active Transportation Plan** is an implementation strategy of the circulation element and must be compliant with the Complete Streets Act, Assembly Bill 1358 (Chapter 657, Statutes of 2008). It provides a blueprint for connecting people with the places that they work, live, play, and go to school with a robust multimodal network.

The Safe Mobility Plan, Circulation Element and Active Transportation Plan should all be consistent with each other.

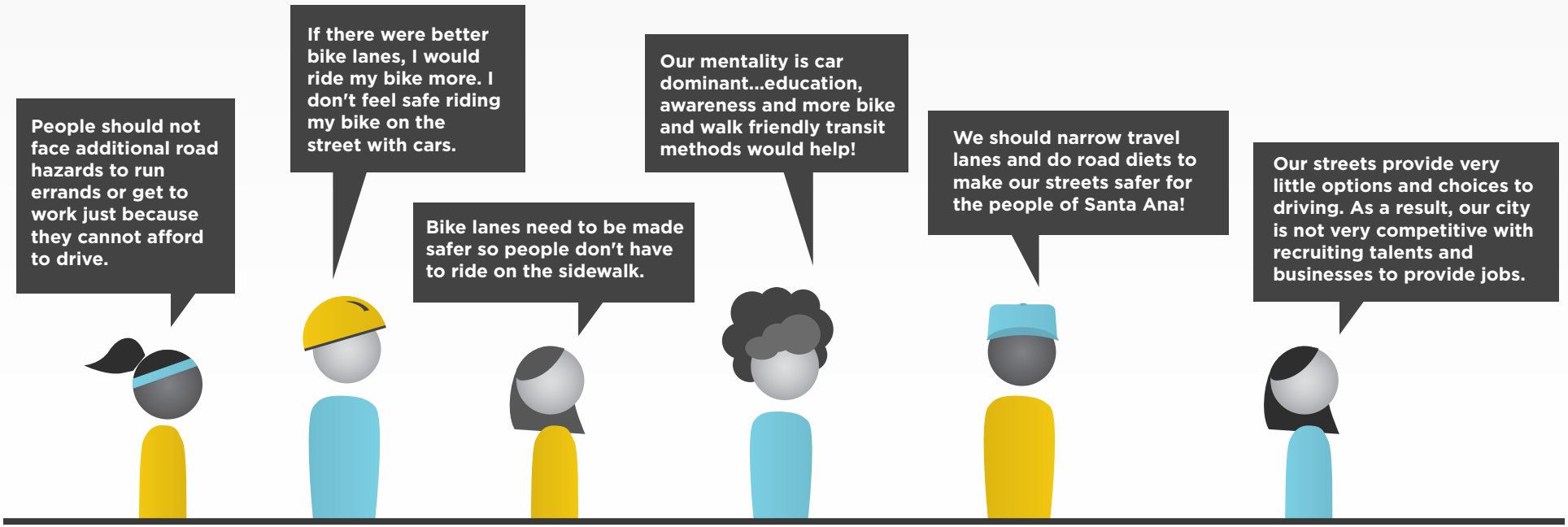
MASTER PLAN OF ARTERIAL HIGHWAYS

These local plans will sometimes conflict with the regional guidance provided by the Orange County Transportation Authority (OCTA) Master Plan of Arterial Highways (MPAH), which was established in 1956 to ensure an integrated regional arterial highway network served the mobility needs of Orange County residents. Today, in order to be eligible for Measure M2 Net Revenues, cities must assure that their Circulation Elements are consistent with the MPAH.

With a focus on safety, many of the recommendations in the Safe Mobility Plan are not consistent with the current MPAH. Traffic studies will be undertaken for the purposes of establishing consistency through reclassification or removal from the MPAH system. Any reclassification will require further evaluation as part of the Circulation Element and coordination with OCTA.



Stakeholders and community survey respondents are concerned about transportation justice and safety in Santa Ana



A detailed collision analysis sets the foundation for the recommendations in this plan.

2

WHAT ARE THE ISSUES?

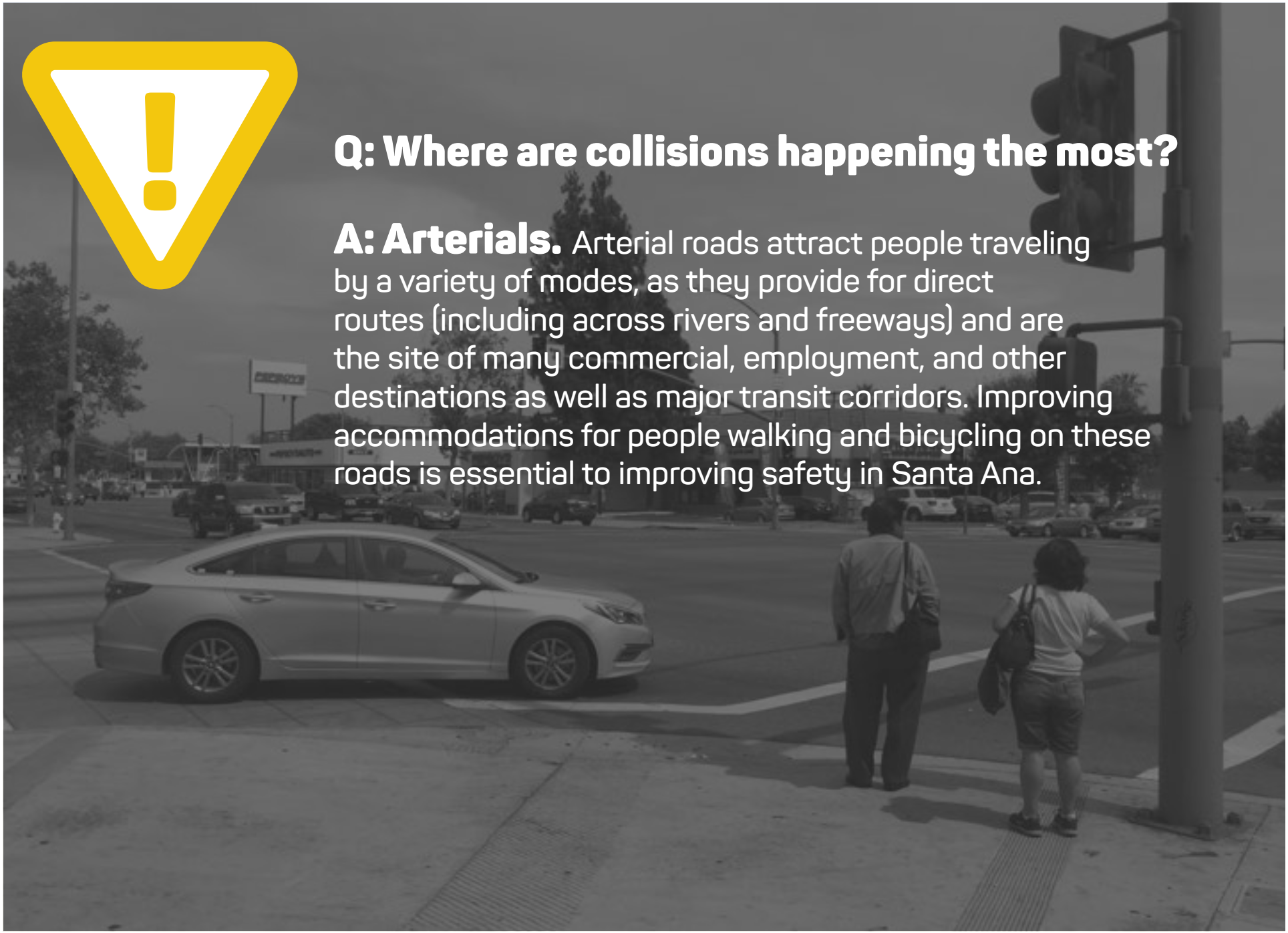
A detailed collision analysis revealed trends in collision types, frequency, severity, and location.

This chapter begins by identifying on what roadways and in what parts of Santa Ana collisions are happening the most. It then identifies what makes collisions more severe, noting conditions and types of collisions that are statistically more likely to result in severe or fatal injuries.

A collision cluster analysis identifies high collision corridors and high collision intersections for pedestrian and bicycle collisions, respectively. For each of these corridors and intersections, Collision Analysis Sheets provide a detailed view into collision trends.

Finally, this chapter presents the most common pedestrian and bicycle collision types in Santa Ana, illustrating their relative frequency, contributing factors, and appropriate solutions.

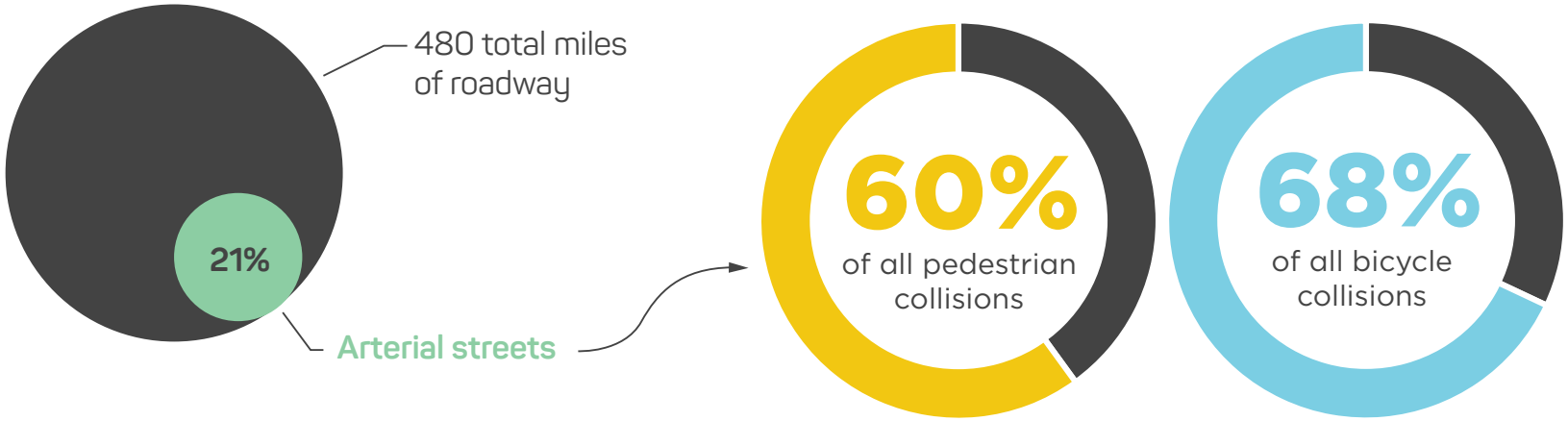
A toolkit of pedestrian and bicycle countermeasures is found in Appendix C: Countermeasure Toolbox.



Q: Where are collisions happening the most?

A: Arterials. Arterial roads attract people traveling by a variety of modes, as they provide for direct routes (including across rivers and freeways) and are the site of many commercial, employment, and other destinations as well as major transit corridors. Improving accommodations for people walking and bicycling on these roads is essential to improving safety in Santa Ana.

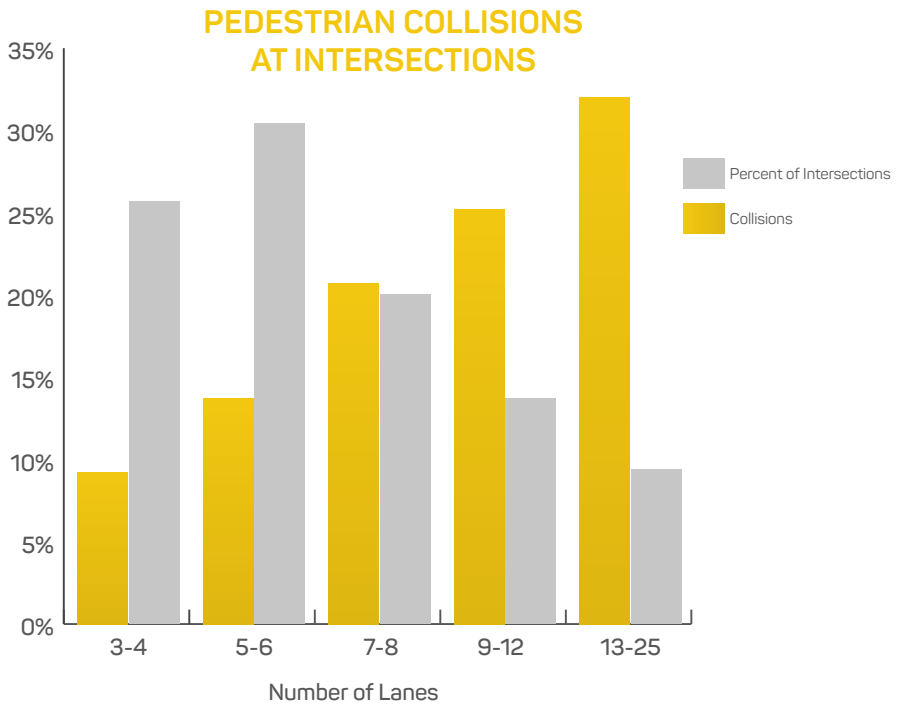
Arterial streets account for just 21% of the street network, but 60% of all pedestrian collisions and 68% of all bicycle collisions occur on them.

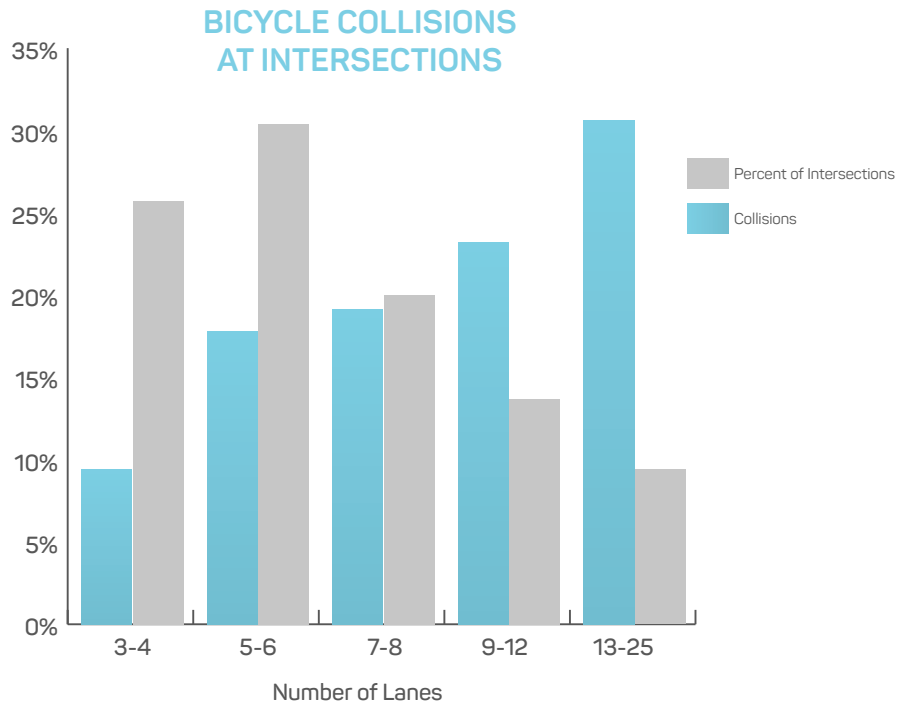


Q: Where are collisions happening the most?

A: Large intersections. Larger intersections tend to increase complexity for all roadway users and result in a higher length of time to cross the intersection and more time in which a pedestrian can be exposed to motor vehicles.

The number of lanes in the intersection is associated with an increase in the number of pedestrian and bicycle collisions.

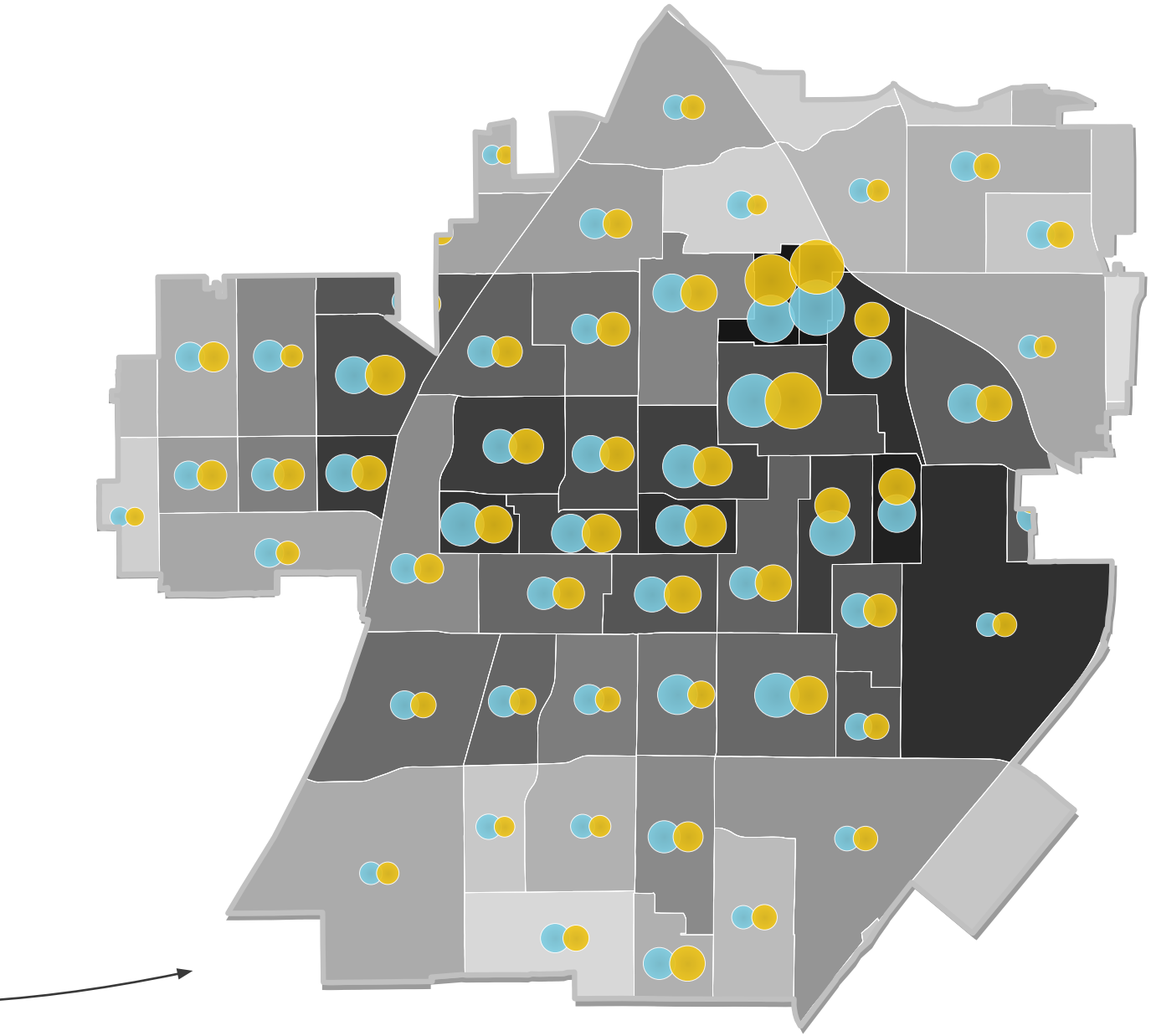




Q: Where are collisions happening the most?

A: In areas with higher concentrations of poverty, low education, youth, and Latino populations.

The lack of a truly multi-modal transportation system places lower income, youth, and Latino populations that are more reliant on walking, bicycling, and transit at risk.



TOTAL COLLISIONS IN SANTA ANA CENSUS TRACTS

NUMBER OF PEDESTRIAN COLLISIONS

- Low
- Medium
- High

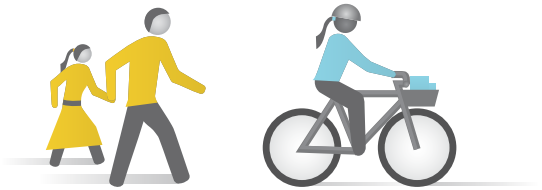
NUMBER OF BICYCLE COLLISIONS

- Low
- Medium
- High

CONCENTRATIONS OF:
YOUTH
POVERTY
HISPANIC/LATINO
LOW EDUCATION

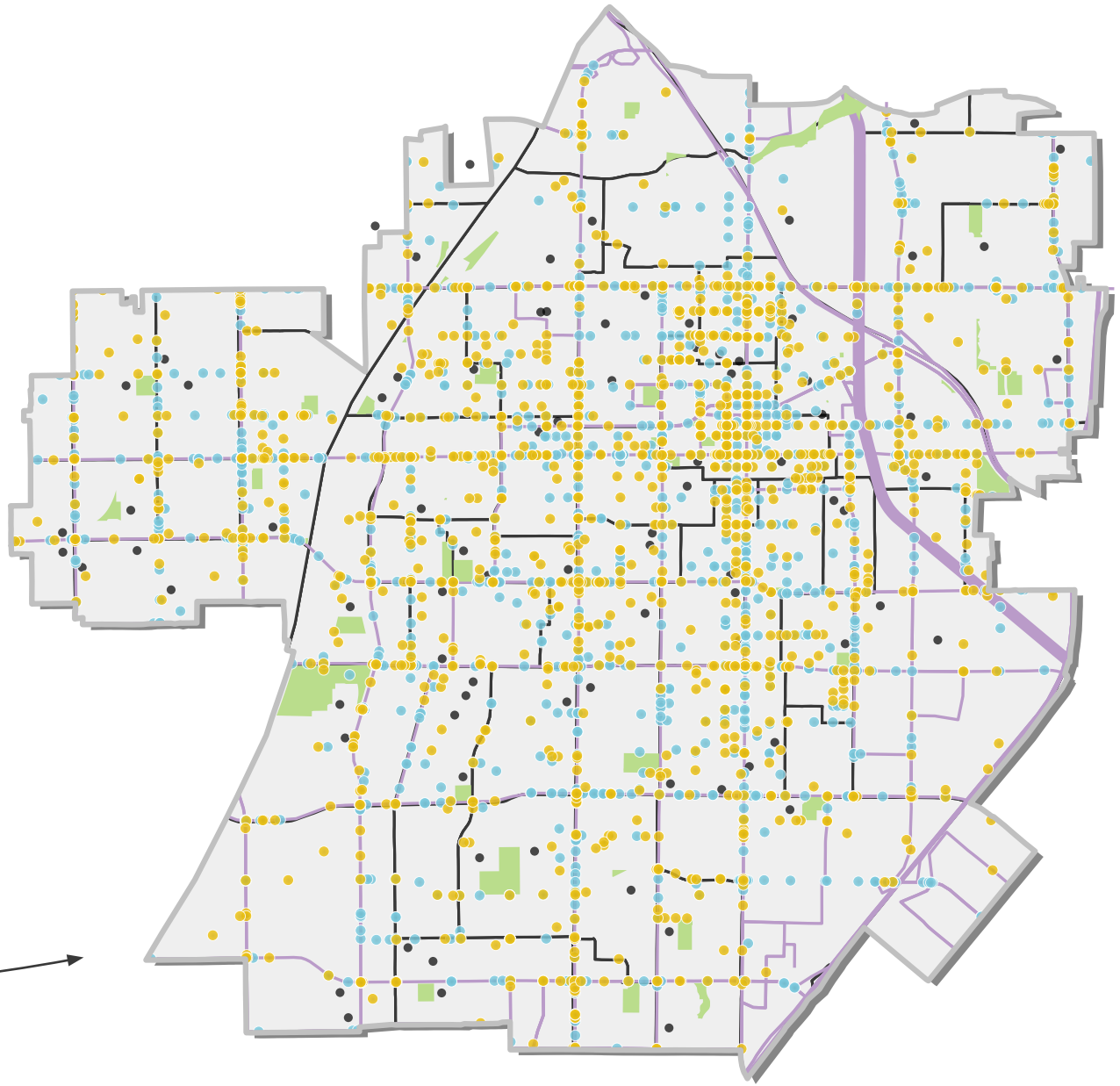
Low

High



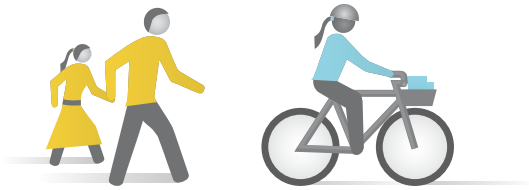
Q: Where are collisions happening the most?

A: In parts of the community that should be the most walkable. Pedestrian and bicycle collisions are more likely to occur in areas of high concentration of schools, parks, and transit stops. The City of Santa Ana seeks to implement design changes to support and enhance safety where more people walk and bicycle.



COLLISIONS AND KEY DESTINATIONS

- Pedestrian Collisions
- Bicyclist Collisions
- Transit Line
- Schools
- Parks



Q: What makes collisions more severe?

1. ROADWAYS WITH MORE LANES

Pedestrian collisions on roads with more travel lanes are more likely to result in a severe or fatal injury. Wider roadways encourage higher travel speeds, which increase the risk for vulnerable roadway users.

2. ROADWAYS WITH HIGHER SPEEDS

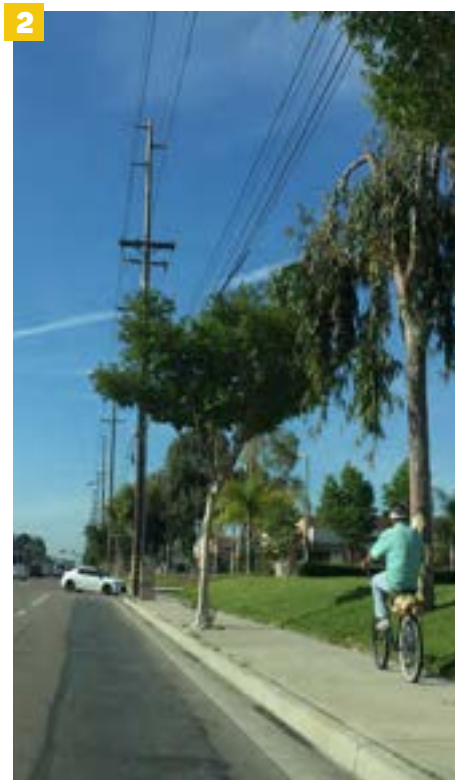
Pedestrian collisions on roads with higher posted speeds are more likely to result in a severe or fatal injury. Higher speeds increase the likelihood that a collision will result in a severe or fatal injury.

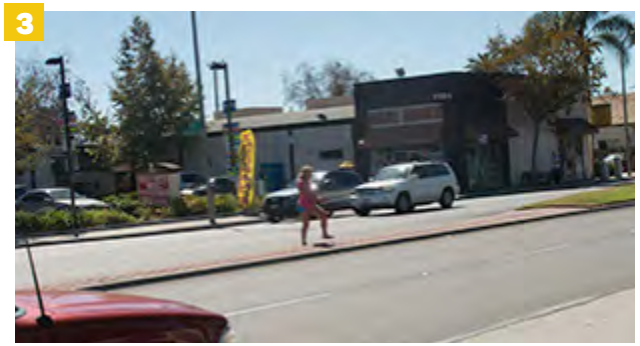
3. MID-BLOCK PEDESTRIAN COLLISIONS

Pedestrians collisions at mid-block locations are more likely to result in a severe or fatal injury. Pedestrians crossing a road at a mid-block location are likely to encounter faster moving vehicles.

4. COLLISIONS INVOLVING IMPAIRED USERS

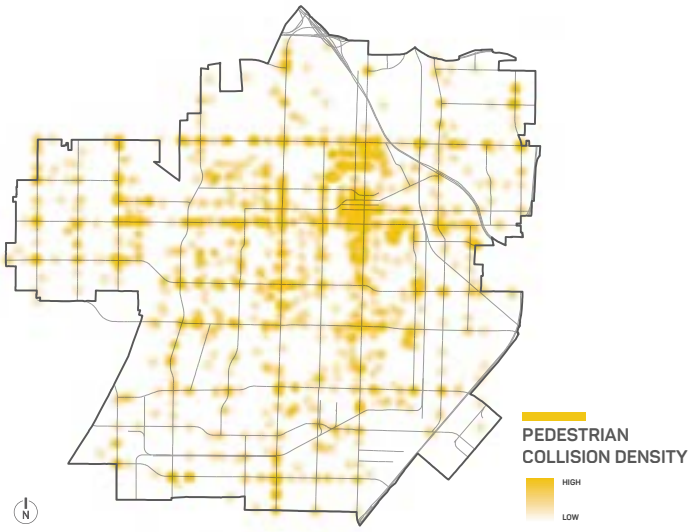
Collisions involving an impaired user (driver, pedestrian, or bicyclist) are more likely to result in a severe or fatal injury. Drinking impairs judgment for all roadway users. Santa Ana's large and fast moving roads are intolerant of mistakes.

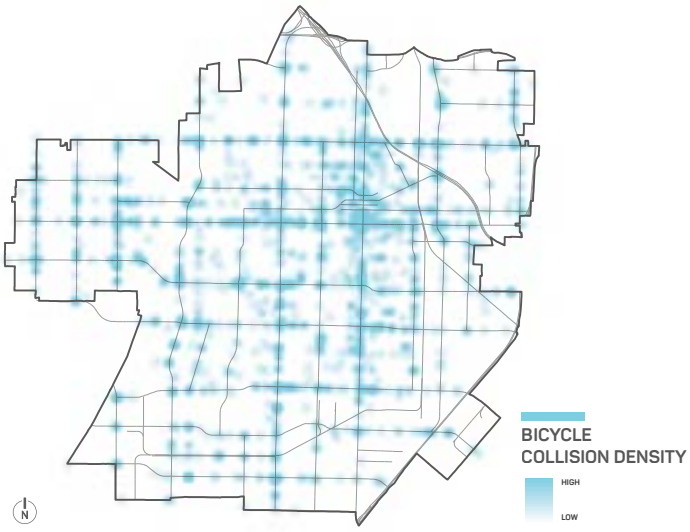




Q: Where should infrastructure investments be focused?

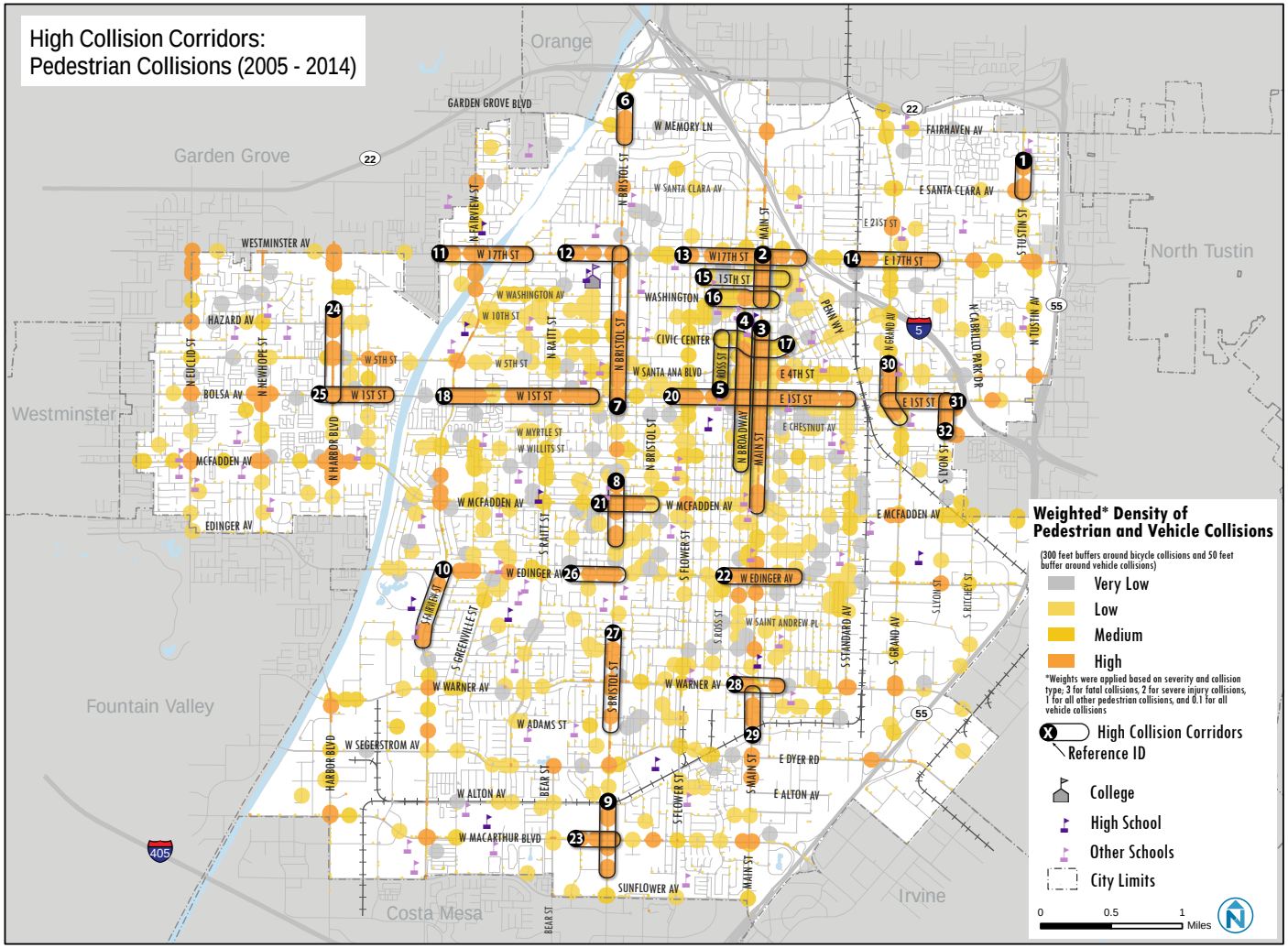
Pedestrian and bicycle high collision corridors have a high concentration of vehicle only collisions as well. Infrastructure improvements that bring down speeds and separate vulnerable roadway users from moving traffic will make streets safer for all modes.
The maps on this page show the distribution of collisions of all modes to show how collisions involving vulnerable users compare to motor vehicle only collisions.

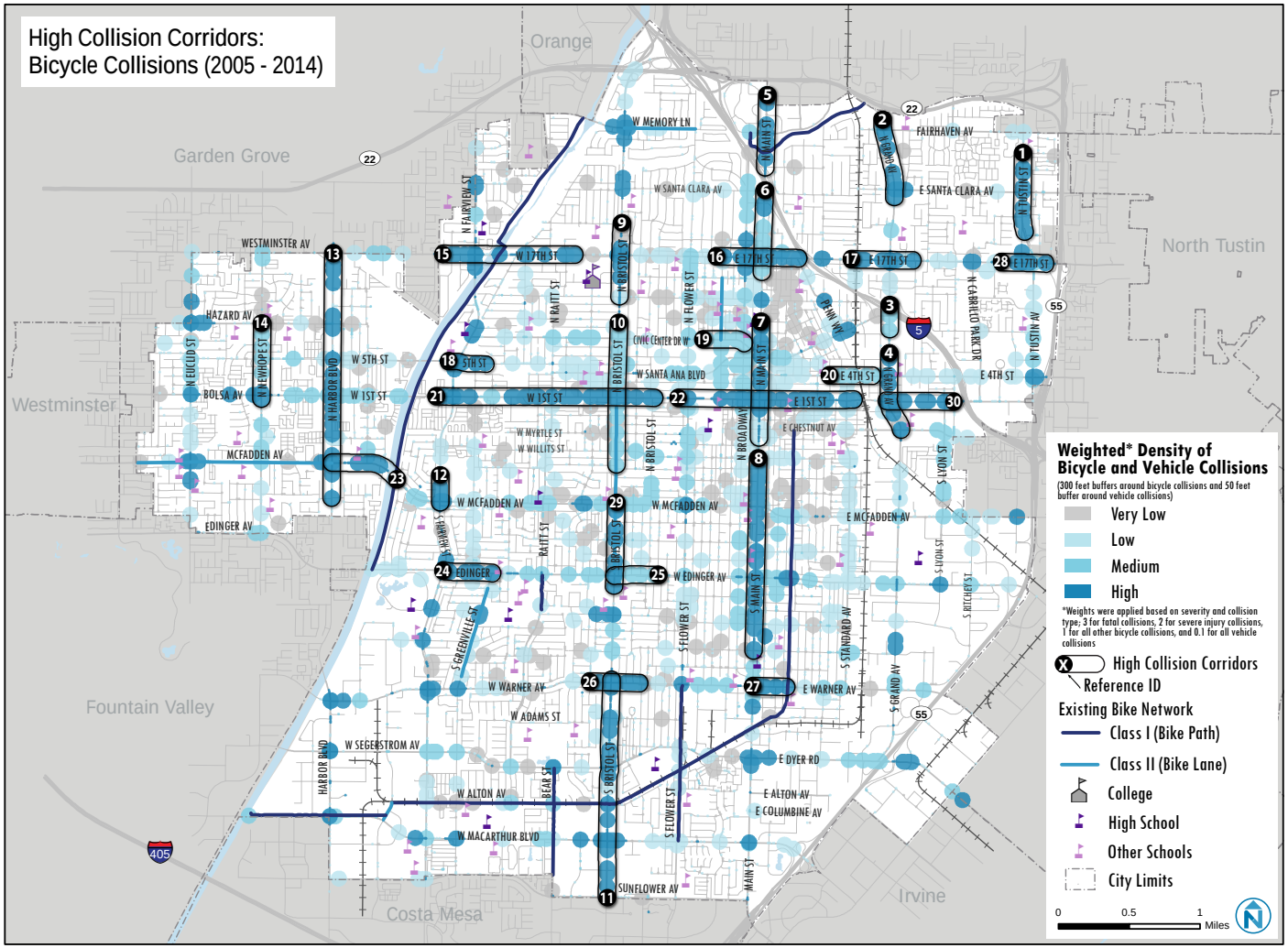




Pedestrian and Bicycle Collisions Happen Throughout Santa Ana

High collision corridors and high collision intersections were identified through a process that measured the density of collisions located in close proximity to each other over the last ten years of available data. Collisions were weighted based on severity. High Collision Corridors for Pedestrians and Bicycles, which are mainly Major Principal Arterials, are illustrated in the maps at right.




High Collision Corridors:
Bicycle Collisions (2005 - 2014)
Orange
Garden Grove
Westminster
Fountain Valley
Costa Mesa
Irvine
North Tustin
W MEMORY LN
W SANTA CLARA AV
E SANTA CLARA AV
FAIRHAVEN AV
WESTMINSTER AV
HAZARD AV
BOLSA AV
MCFADDEN AV
EDINGER AV
W 17TH ST
E 17TH ST
W 5TH ST
W 1ST ST
E 1ST ST
E 4TH ST
W SANTA ANA BLVD
CIVIC CENTER DR W
W MYRTLE ST
W WILLITS ST
E CHESTNUT AV
W MCFADDEN AV
E MCFADDEN AV
W EDINGER AV
W WARNER AV
E WARNER AV
W ADAMS ST
W SEGERSTROM AV
W ALTON AV
E ALTON AV
E COLUMBINE AV
E DYER RD
W MACARTHUR BLVD
SUNFLOWER AV
N MAIN ST
S MAIN ST
N BROADWAY
N BRISTOL ST
S BRISTOL ST
N HARBOR BLVD
S HARBOR BLVD
N EUCLID ST
N EWHOPE ST
N FAIRVIEW ST
N RAITT ST
S RAITT ST
N FLOWER ST
S FLOWER ST
S GREENVILLE ST
BEAR ST
N TUSTIN ST
N GARFIELD PARK DR
N NEWHOPE ST
S STANDARD AV
S GRAND AV
S RITCHEY ST
S OLIVE ST
405
5
22
55
Weighted* Density of Bicycle and Vehicle Collisions
(300 feet buffers around bicycle collisions and 50 feet buffer around vehicle collisions)
Very Low
Low
Medium
High
*Weights were applied based on severity and collision type; 3 for fatal collisions, 2 for severe injury collisions, 1 for all other bicycle collisions, and 0.1 for all vehicle collisions
High Collision Corridors
Reference ID
Existing Bike Network
Class I (Bike Path)
Class II (Bike Lane)
College
High School
Other Schools
City Limits
0
0.5
1
Miles

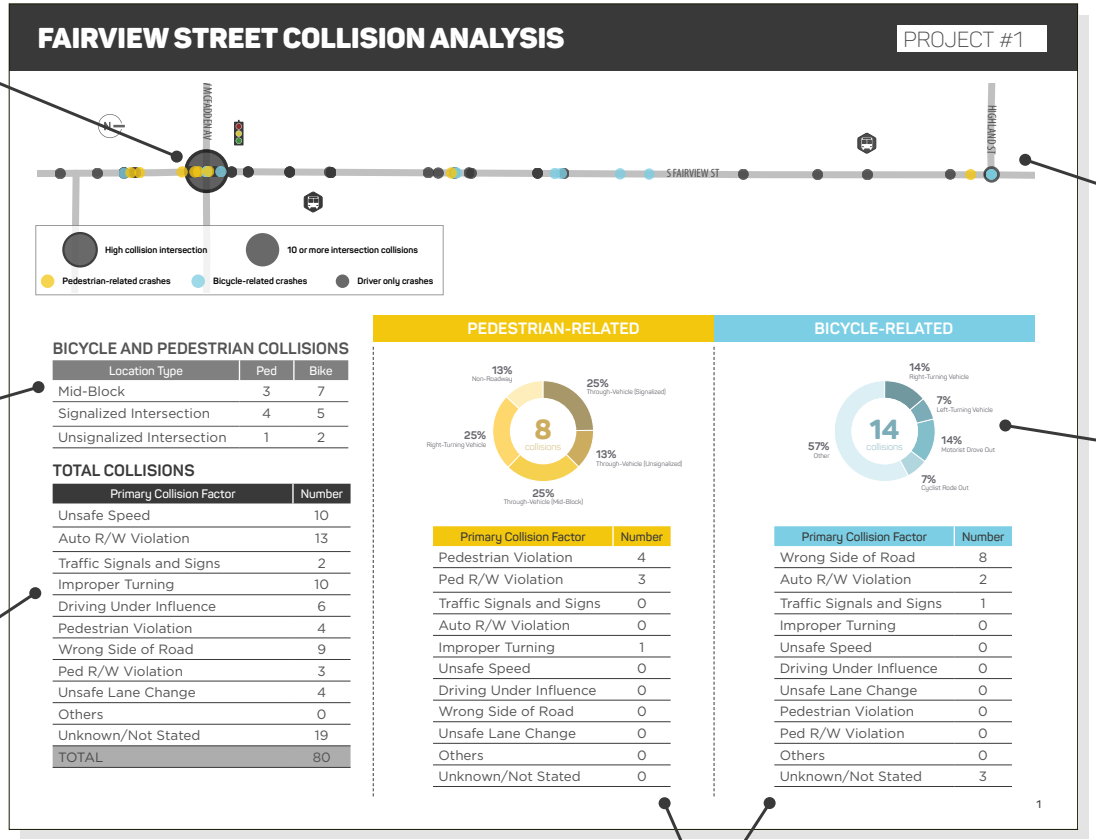
Collision Analysis Sheets

The High Collision Corridors and Intersections for Pedestrians and Bicycles were used to develop a combined list of Proposed Project Locations, which is illustrated in the map on the following page. A series of collision worksheets were developed that corresponded to each of the preliminary project locations. The diagram below provides a sample worksheet, along with instructions to assist with interpretation. The full set of collision analysis worksheets is found in Appendix A. .

Project Number
Proposed project, based on the collision analysis.

Corridor Name

High Collision Intersections
Large circles denote intersections with 10 or more collisions (all modes). A black outline indicates the intersection was identified as a high collision intersection for pedestrian or bicycle collisions.



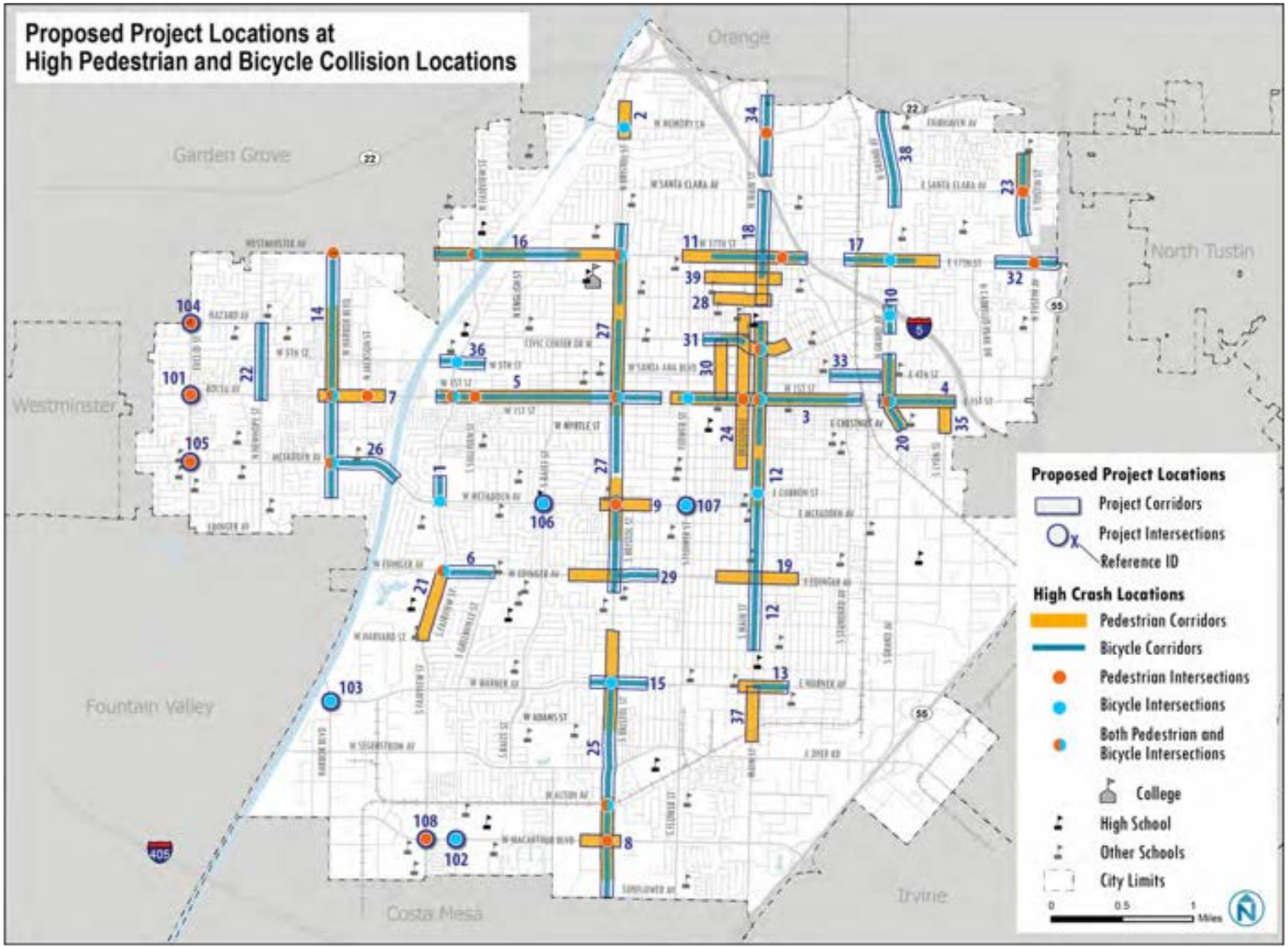
Map of Collisions
Shows the locations of pedestrian, bicycle, and driver collisions along the corridor.

Collision Location
Identifies the distribution of pedestrian and bicycle collisions by location.

Collision Types
The pie charts indicate the distribution of pedestrian and bicycle-involved collisions by collision type.

Primary Collision Factor
Primary collision factors (all modes), as identified on the collision report forms.

Mode-specific Primary Collision Factors
Primary collision factors (as identified on the collision report forms) for pedestrian and bicycle-involved collisions, respectively.


Proposed Project Locations at
High Pedestrian and Bicycle Collision Locations
Orange
Garden Grove
Westminster
Fountain Valley
Costa Mesa
Irvine
North Tustin
Proposed Project Locations
Project Corridors
Project Intersections
Reference ID
High Crash Locations
Pedestrian Corridors
Bicycle Corridors
Pedestrian Intersections
Bicycle Intersections
Both Pedestrian and Bicycle Intersections
College
High School
Other Schools
City Limits
0
0.5
1
Miles

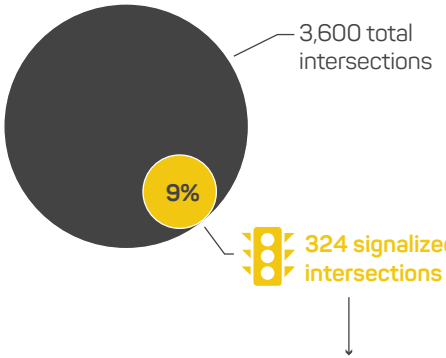
PEDESTRIAN COLLISIONS

Pedestrian Collisions

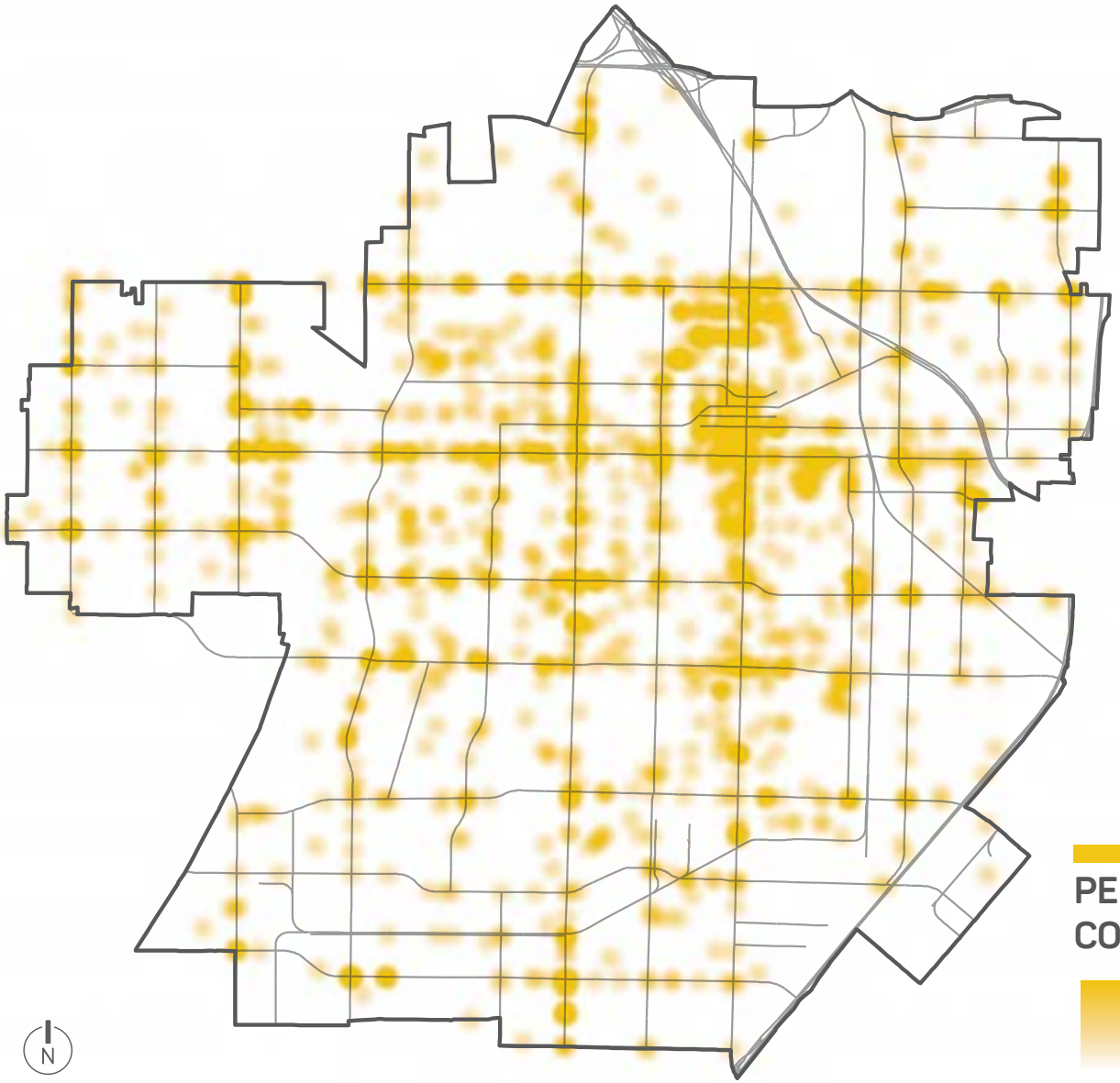
This section presents the predominant pedestrian collision types in Santa Ana, using collision typologies established through the FHWA PEDSAFE Safety Guide and Countermeasure Selection System as a basis. Key findings include:

- Traffic signals are over-represented in pedestrian collisions, as over 35% of pedestrian collisions occur at the 9% of the City's intersections that are signalized.
- A substantial number of collisions at intersections involve a through moving driver hitting a pedestrian in the crosswalk. Through moving vehicle collision patterns at intersections are explained by: pedestrian error (crossing against don't walk), driver error (intoxication; not noticing or running a yellow/red light), or pedestrian running out of time to complete a legal crossing.
- Collisions are evenly split between right turning and left turning vehicles, mostly at signalized intersections. Drivers are nearly always at fault for turning movement collisions.
- Over a third of collisions involve pedestrians crossing mid-block or at an unsignalized intersection.
- Nearly 10% of collisions involve pedestrians crossing near, but not at, marked or unmarked crossings

Traffic signals are not preventing pedestrian and bicycle collisions



More than 50% of intersection collisions take place at signalized intersections for both pedestrians and bicyclists

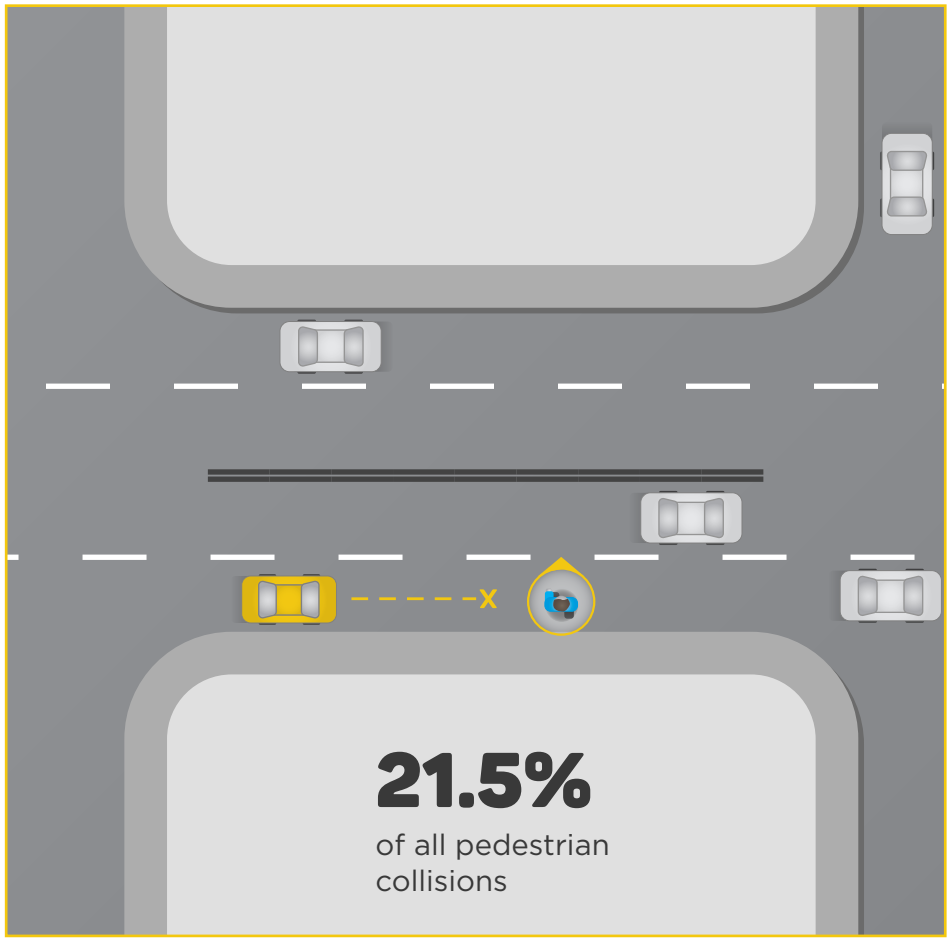

N
PEDESTRIAN
COLLISION DENSITY
HIGH
LOW

Through Vehicle at Mid-Block Location

Mid-block locations are the most likely to result in a severe or fatal injury, since vehicles are usually traveling at speed. Safety can be enhanced by measures that reduce long distances between marked crossings, reduce the size of large roadways, and reduce speeds. Education should remind pedestrians to cross at intersections.

WHAT'S HAPPENING?

» Pedestrians crossing between intersections misjudge the gap in traffic and do not provide drivers sufficient time to stop



SOLUTIONS

ENGINEERING

» Road buffet
» Lane width reduction
» Median refuge island
» Curb extensions
» Rectangular Rapid Flash Beacon (RRFB)
» Bicycle boulevard

EDUCATION

» Cross at the corner - Remind pedestrians (including transit users) to utilize crossings/ cross at intersections

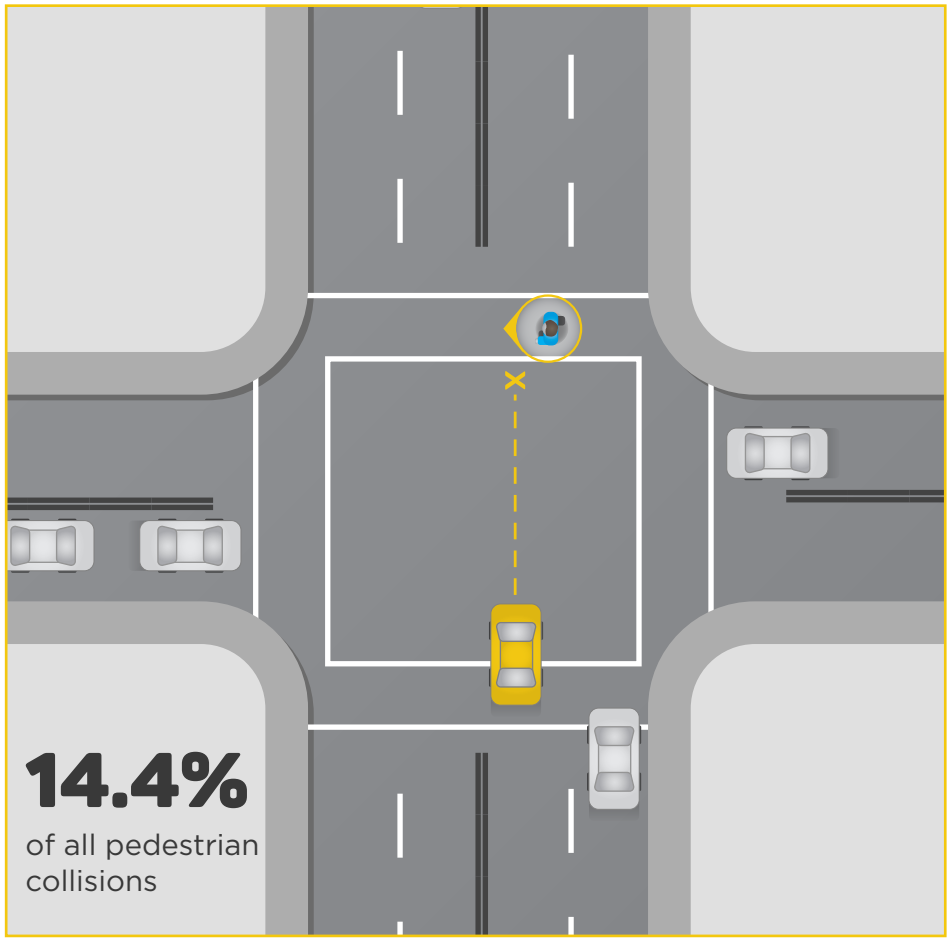
PEDESTRIAN COLLISIONS

Through Vehicle at Unsignalized Intersection

State law requires drivers to yield to a pedestrian crossing within any marked crosswalk or unmarked crosswalk at an intersection. Roadway design can increase visibility and minimize exposure while education can increase awareness of the rules of the road.

WHAT'S HAPPENING?

- Typically involves a driver failing to yield to the pedestrian in the crosswalk (marked or unmarked)
- Occasionally involves a pedestrian running in front of a vehicle



SOLUTIONS

ENFORCEMENT

- Saturation patrols
- Crosswalk enforcement

ENGINEERING

- Road buffet
- Median refuge island
- Curb extensions
- Rectangular Rapid Flash Beacon (RRFB)
- Advanced stop bars
- Bicycle boulevard
- Lane width reduction

EDUCATION

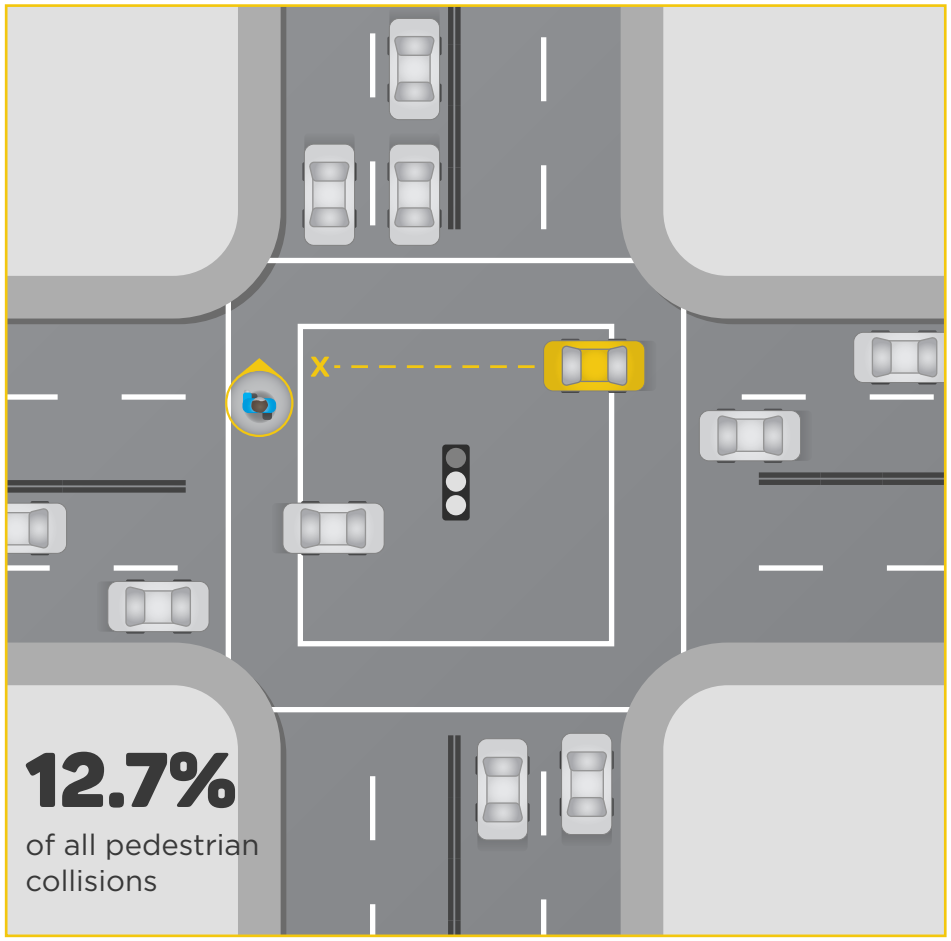
- Yield to pedestrians in crosswalks (marked and unmarked)
- Look before crossing (even when you have the walk signal)
- Slow down for our kids
- Speed kills campaign

Through Vehicle at Signalized Intersection

Traffic signal control does not ensure pedestrian safety. Signalized intersection design and signal operations can support good decision-making and minimize exposure.

WHAT'S HAPPENING?

- Pedestrian crossing against the Don't Walk signal
- Driver ran a red light
- Driver accelerates at a green light and hits a pedestrian that ran out of time to complete the crossing
- Pedestrian crossed near, but outside of the crosswalk



SOLUTIONS

ENFORCEMENT

- Saturation patrols

ENGINEERING

- Median refuge island
- Road buffet
- Signal modifications
- Curb extensions
- Curb radius reduction
- Lane width reduction

EDUCATION

- Yield to pedestrians in crosswalks (marked and unmarked)
- Look before crossing (even when you have the walk signal)
- Slow down for our kids
- Speed kills campaign

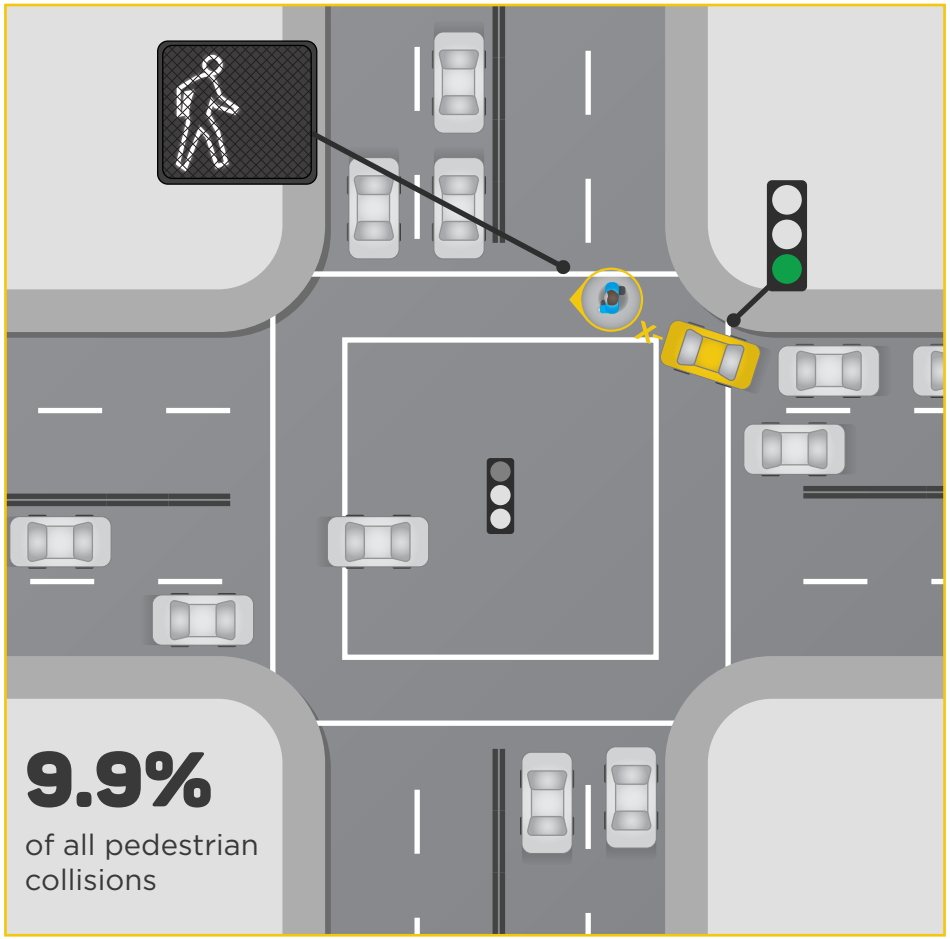
PEDESTRIAN COLLISIONS

Right Turning Vehicle at Signalized Intersection

Turning vehicles must watch out for pedestrians crossing with the walk signal (and vice versa). Safety can be enhanced through protected signal phases, leading pedestrian intervals, increasing visibility, and education.

WHAT'S HAPPENING?

- Typically involves a driver failing to yield to the pedestrian in the crosswalk
- Occasionally involves a pedestrian crossing against the signal or running in front of a turning vehicle



9.9%
of all pedestrian collisions

SOLUTIONS

ENGINEERING

- Curb radius reduction
- Curb extensions
- Signal modifications
- Regulatory and warning signs
- Road buffet

EDUCATION

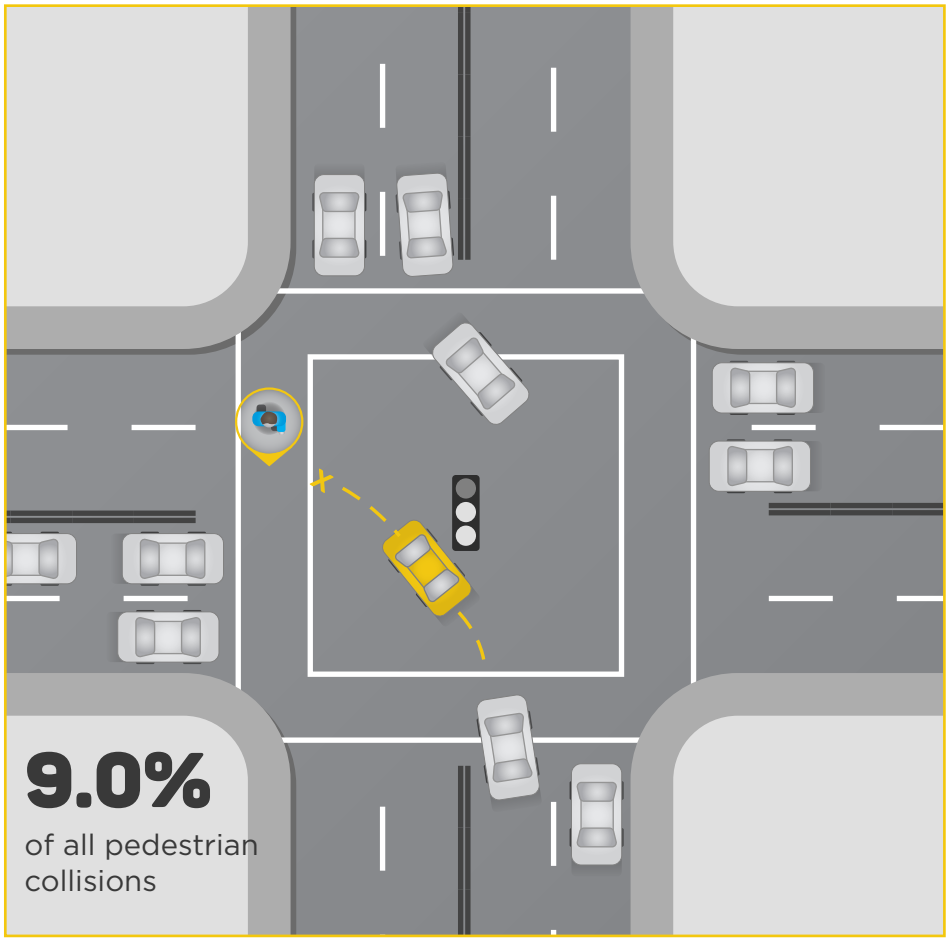
- Yield to pedestrians in crosswalks (marked and unmarked)
- Look before crossing (even when you have the walk signal)

Left Turning Vehicle at Signalized Intersection

Left turning vehicles must look for gaps in oncoming traffic while also noticing pedestrians in the crosswalk. Safety can be enhanced through protected signal phases, leading pedestrian intervals, increasing visibility, and education.

WHAT'S HAPPENING?

- Typically involves a driver failing to yield to the pedestrian in the crosswalk
- Occasionally involves a driver with a green light hitting a pedestrian legally completing their crossing



SOLUTIONS

ENGINEERING

- Signal modifications
- Road buffet
- Median refuge island
- Curb radius reduction
- Curb extensions

EDUCATION

- Yield to pedestrians in crosswalks (marked and unmarked)
- Look before crossing (even when you have the walk signal)

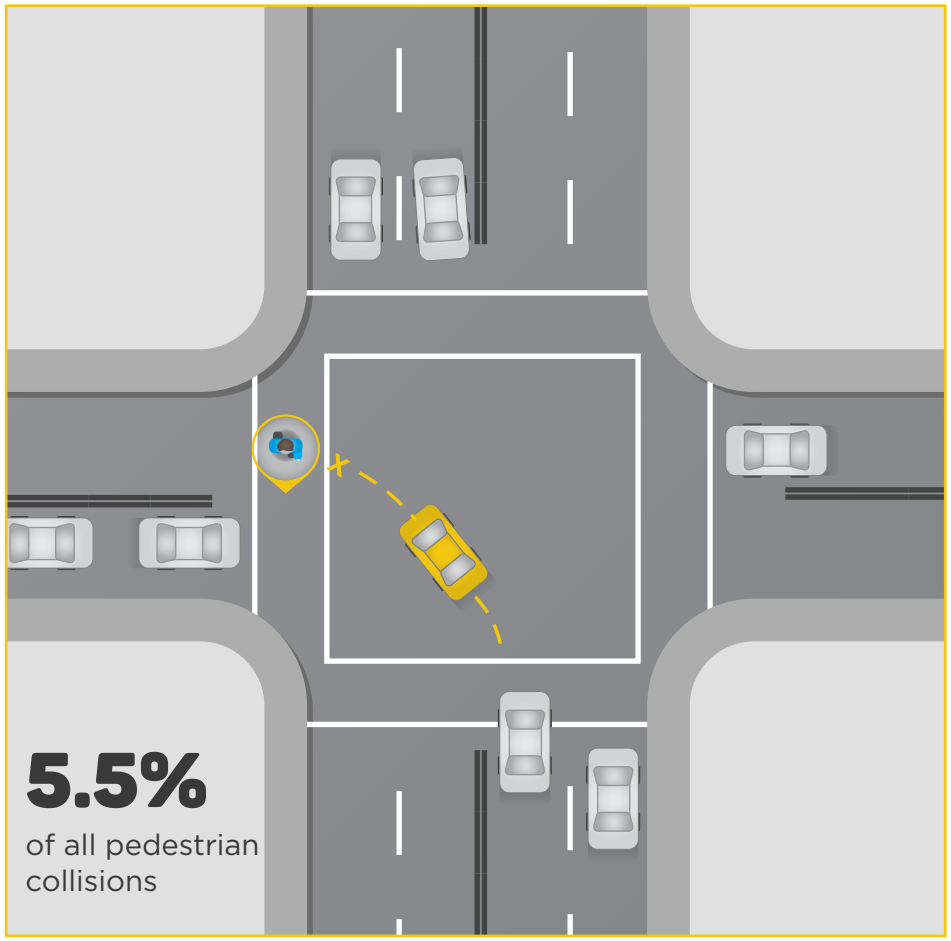
PEDESTRIAN COLLISIONS

Turning Vehicle at Unsignalized Intersection

State law requires drivers to yield to a pedestrian crossing within any marked crosswalk or unmarked crosswalk at an intersection. Safety can be improved through measures that increase visibility and minimize turning speeds, while education can increase awareness of the rules of the road.

WHAT'S HAPPENING?

» Typically involves a driver failing to yield to the pedestrian in the crosswalk (marked or unmarked)



SOLUTIONS

ENFORCEMENT

» Crosswalk enforcement

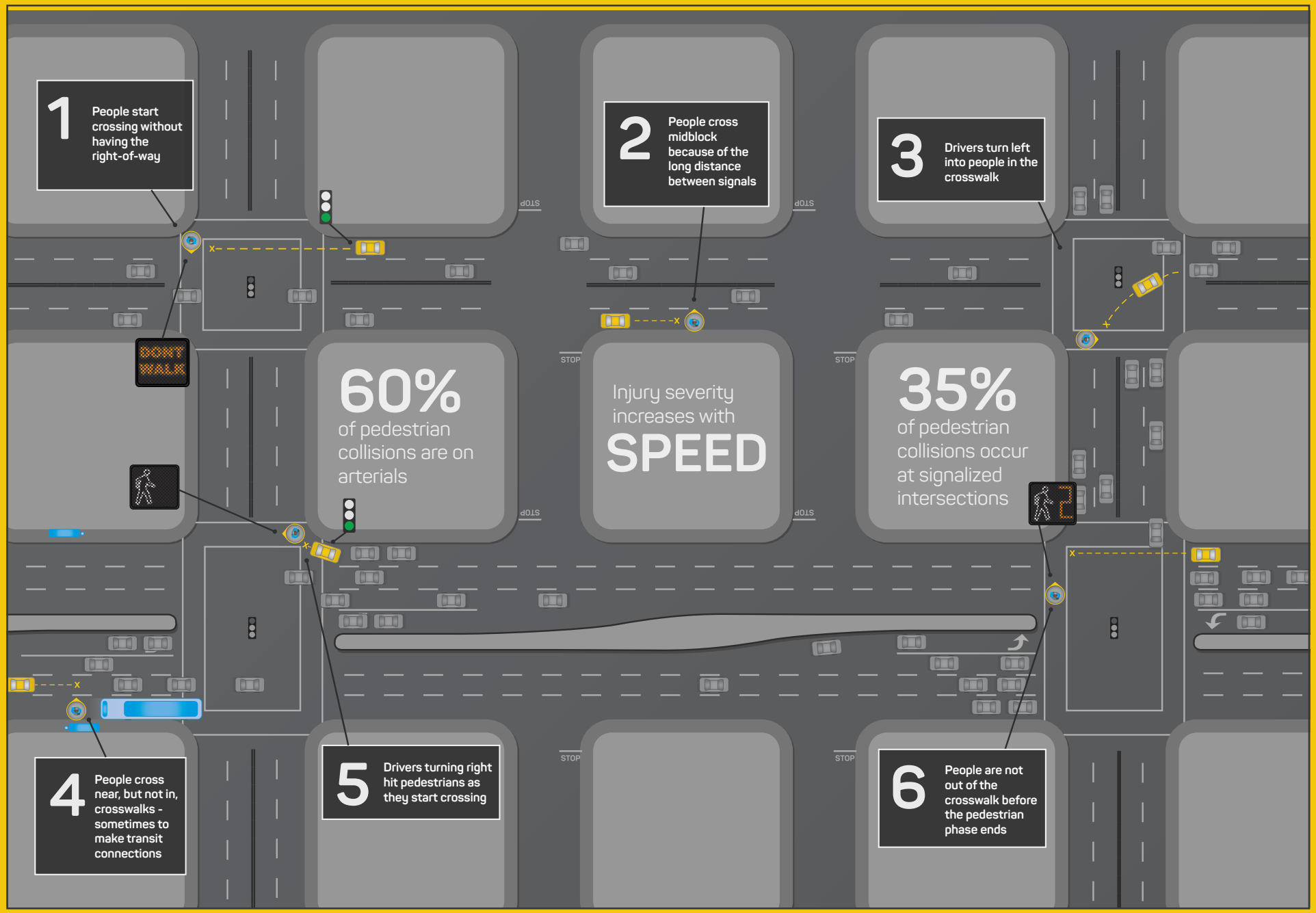
ENGINEERING

» Median refuge island
» Curb extensions
» Curb radius reduction
» Road buffet

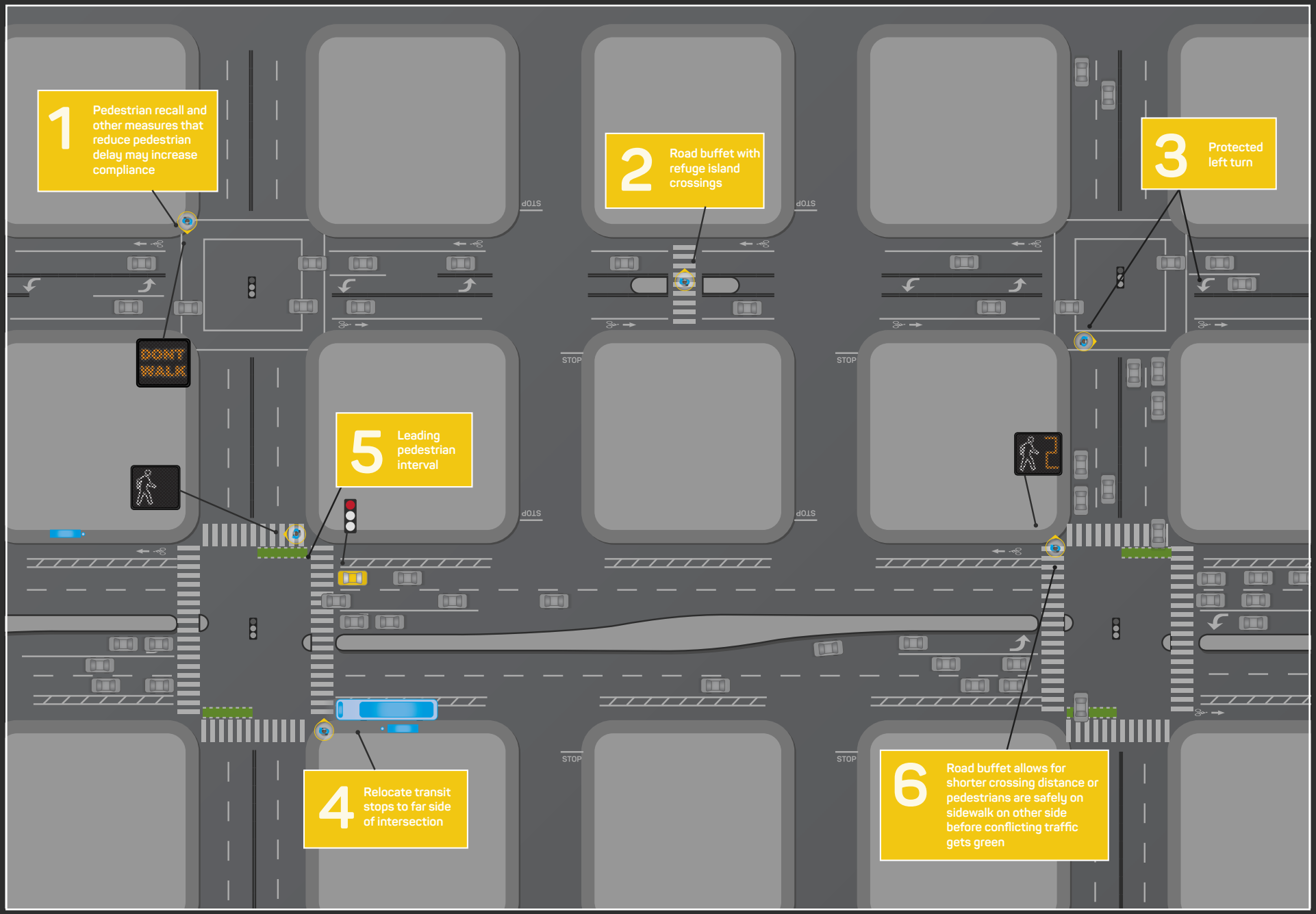
EDUCATION

» Yield to pedestrians in crosswalks (marked and unmarked)
» Look before crossing (even when you have the walk signal)

TYPICAL COLLISIONS INVOLVING PEDESTRIANS



SOLUTIONS TO COLLISIONS INVOLVING PEDESTRIANS



BICYCLE COLLISIONS

Bicycle Collisions

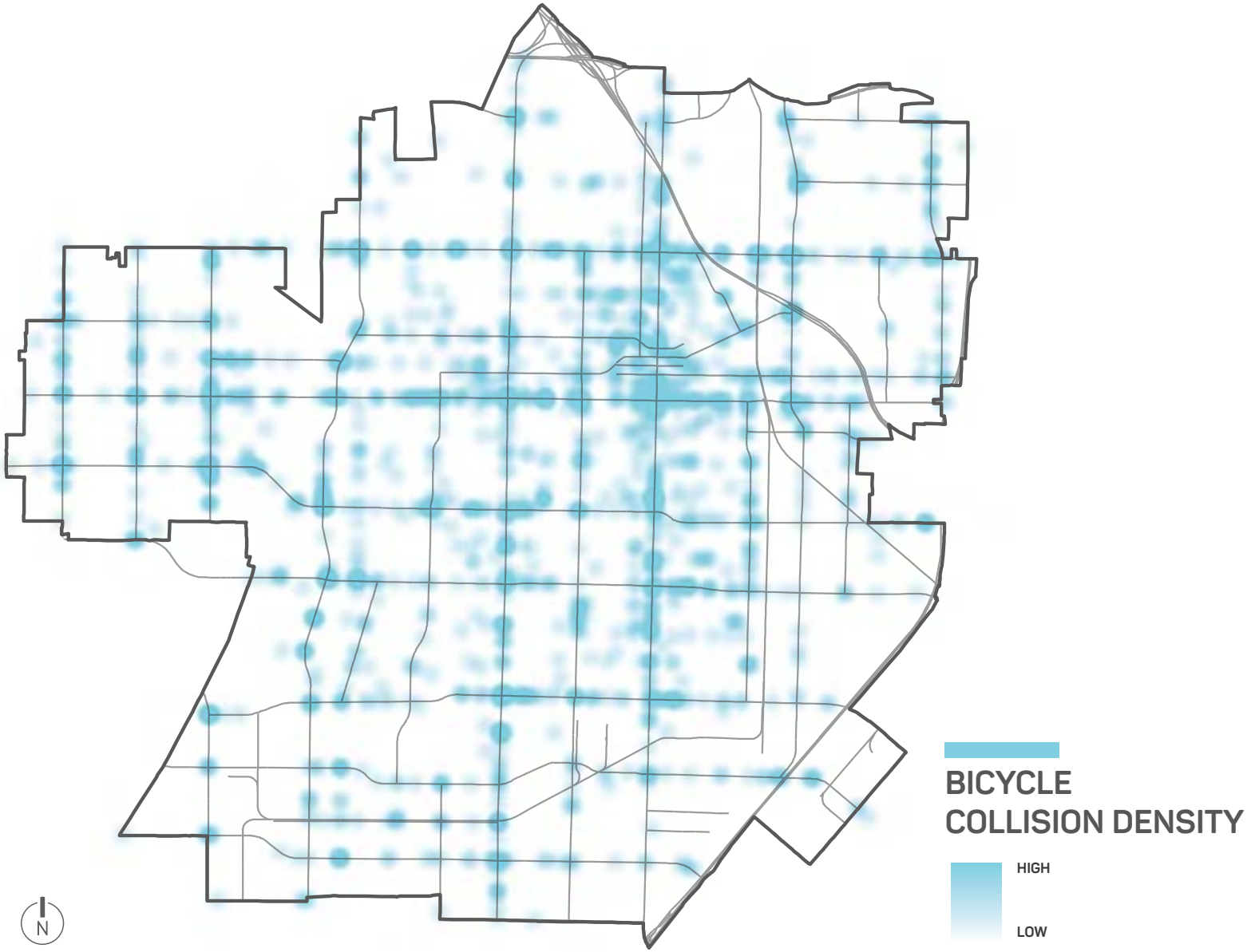
This section presents the predominant bicycle collision types in Santa Ana, using collision typologies established through the FHWA BIKESAFE Safety Guide and Countermeasure Selection System as a basis.

THE ROLE OF WRONG WAY AND SIDEWALK RIDING IN BICYCLE COLLISIONS

With many very large and fast moving streets in Santa Ana, many people on bicycles choose to ride the wrong way (facing traffic) or on the sidewalk. While riding against traffic or on the sidewalk may be a logical response to the lack of bicycle infrastructure, it results in a situation where motorists may encounter a bicyclist unexpectedly, contributing to the risk of bicycle involved collisions. Safe and comfortable facilities are needed so people on bicycles feel confident riding on the street and in the same direction as traffic. Sidewalk and wrong way riding are particularly noteworthy in the following instances:

- **Collisions with Turning Vehicles** - Bicyclist colliding with a right turning vehicle is the most common bicycle collision type. Collisions with right turning vehicles at intersections frequently involve a bicyclist riding off of the sidewalk and into the intersection, where they may be traveling too fast for a motorist to notice them and have time to stop. More than half of collisions with right turning vehicles involve a bicyclist traveling the wrong way.
- **Driveways** - Motorist drove out – mid-block (i.e. a driveway) is the second highest collision type, and more than half of these collisions involve a bicyclist traveling the wrong way, often on the sidewalk. It appears that many driveway collisions could be eliminated through the provision of an on-street bicycle network utilized by bicyclists traveling in the same direction as traffic.

People ride on the sidewalk in communities without separate bicycle facilities because they don't feel safe.

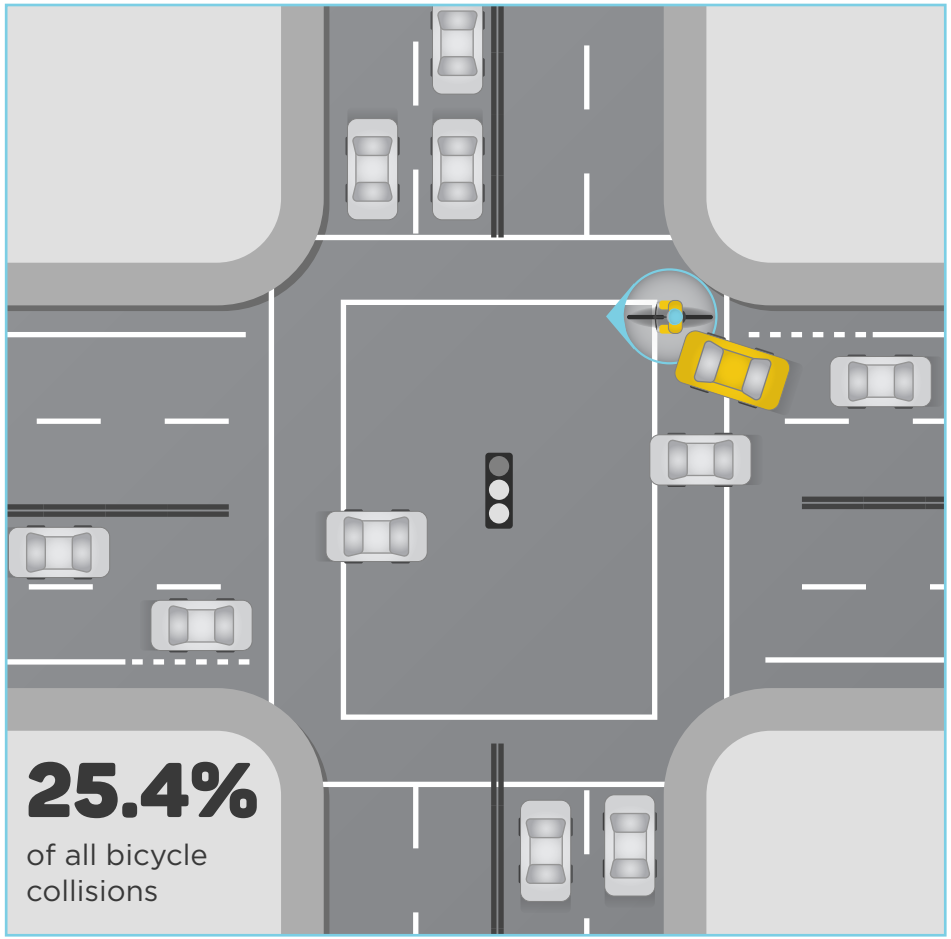

N
BICYCLE
COLLISION DENSITY
HIGH
LOW

Motorist turned or merged right into path of bicycle

Colliding with a right turning vehicle is the most common bicycle collision type. With a limited bike network, many bicyclists enter an intersection from the sidewalk or traveling the wrong way (on the street or sidewalk), where motorists don't expect them. Education and comfortable bicycle facilities that encourage bicyclists to ride on the street and with traffic can reduce the prevalence of this type of collision.

WHAT'S HAPPENING?

- Frequently involve a bicyclist riding off of the sidewalk and into the intersection, where they may be traveling too fast for a motorist to notice them and have time to stop
- More than half of collisions with right turning vehicles involve a bicyclist traveling the wrong way



SOLUTIONS

ENGINEERING

- Protected bike lane
- Bike lane
- Bicycle boulevard
- Road buffet

EDUCATION

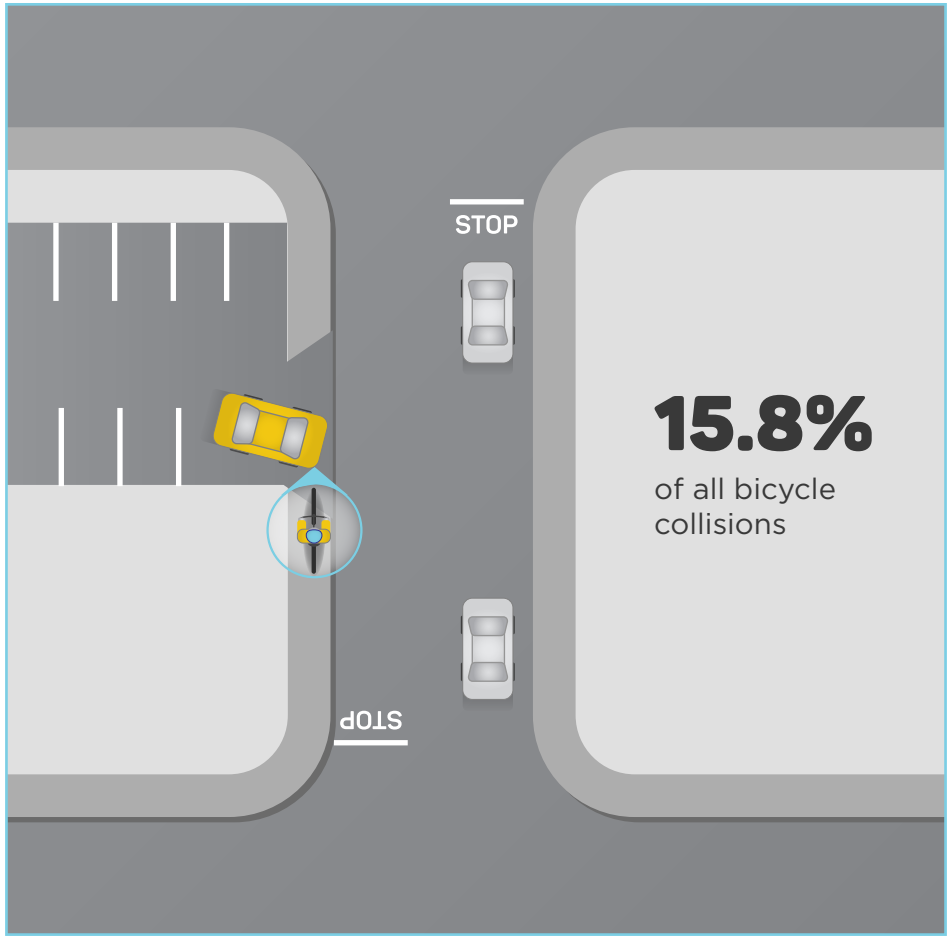
- Look in your blind spot (for bikes) before turning
- Ride predictably - Wrong way riding is dangerous
- Ride predictably - Sidewalk riding is dangerous
- Enter crosswalk at walking speed (and on right side of road) to avoid collisions with turning vehicles

Motorist drove out mid-block

Motorist drove out mid-block is the second most frequent collision type. The bicyclist was frequently traveling on the sidewalk or traveling the wrong way (on the street or sidewalk), where motorists don't expect them. Education and comfortable bicycle facilities that encourage bicyclists to ride on the street and with traffic can reduce the prevalence of this type of collision.

WHAT'S HAPPENING?

- More than half of these collisions involve a bicyclist traveling the wrong way, often on the sidewalk
- A smaller amount involve the bicyclist traveling with traffic, either on the sidewalk or on the road, prior to the collision



SOLUTIONS

ENFORCEMENT

- Wrong way riding enforcement
- Sidewalk riding enforcement

ENGINEERING

- Protected bike lane
- Bike lane
- Corridor access management
- Road buffet

EDUCATION

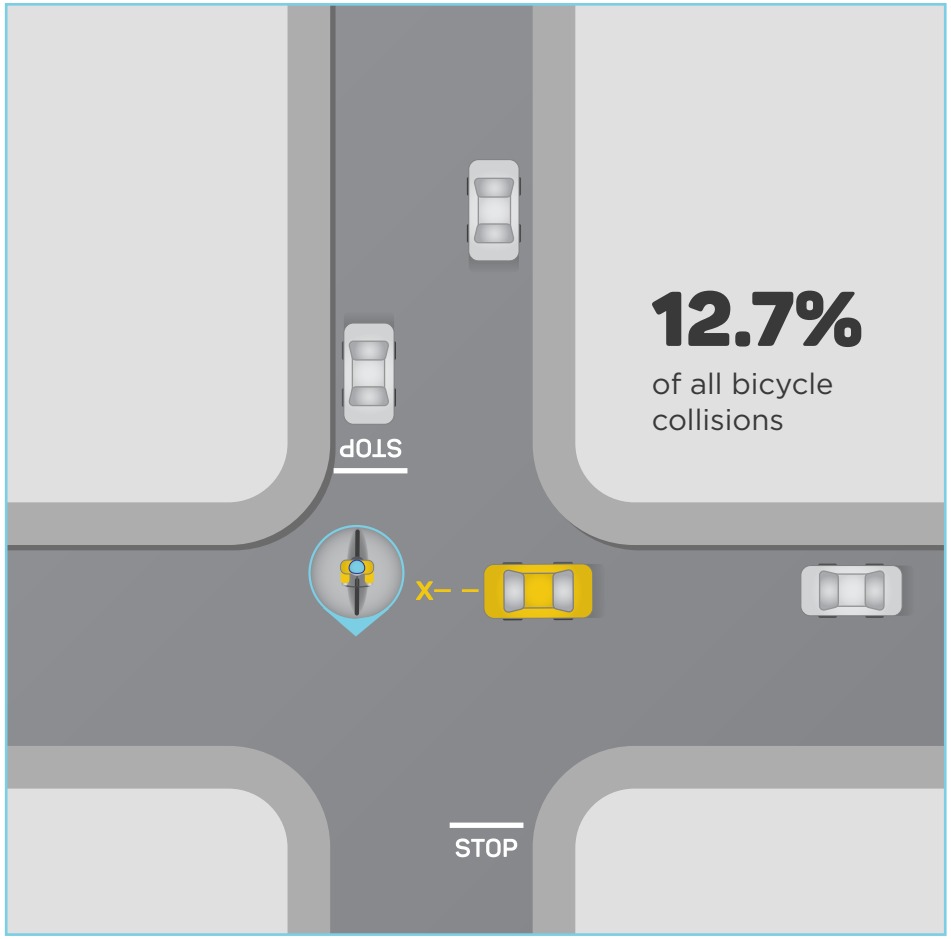
- Ride predictably - Wrong way riding is dangerous
- Ride predictably - Sidewalk riding is dangerous

Bicycle failed to yield at an intersection

Bicycles are considered vehicles by law and are required to obey traffic controls. On street bicycle facilities as well as bicycle detection at signalized intersections can reinforce this notion. Education is needed to alert people they are required to stop at red lights and stop signs and that failure to do so is dangerous.

WHAT'S HAPPENING?

- Bicycle fails to stop at a red light or stop sign
- Unsignalized and signalized intersections are equally prevalent in the data for this collision type
- Wrong way riding is a contributing factor for some collisions



SOLUTIONS

ENFORCEMENT

- Traffic control enforcement

ENGINEERING

- Bicycle boulevard
- Signal modifications

EDUCATION

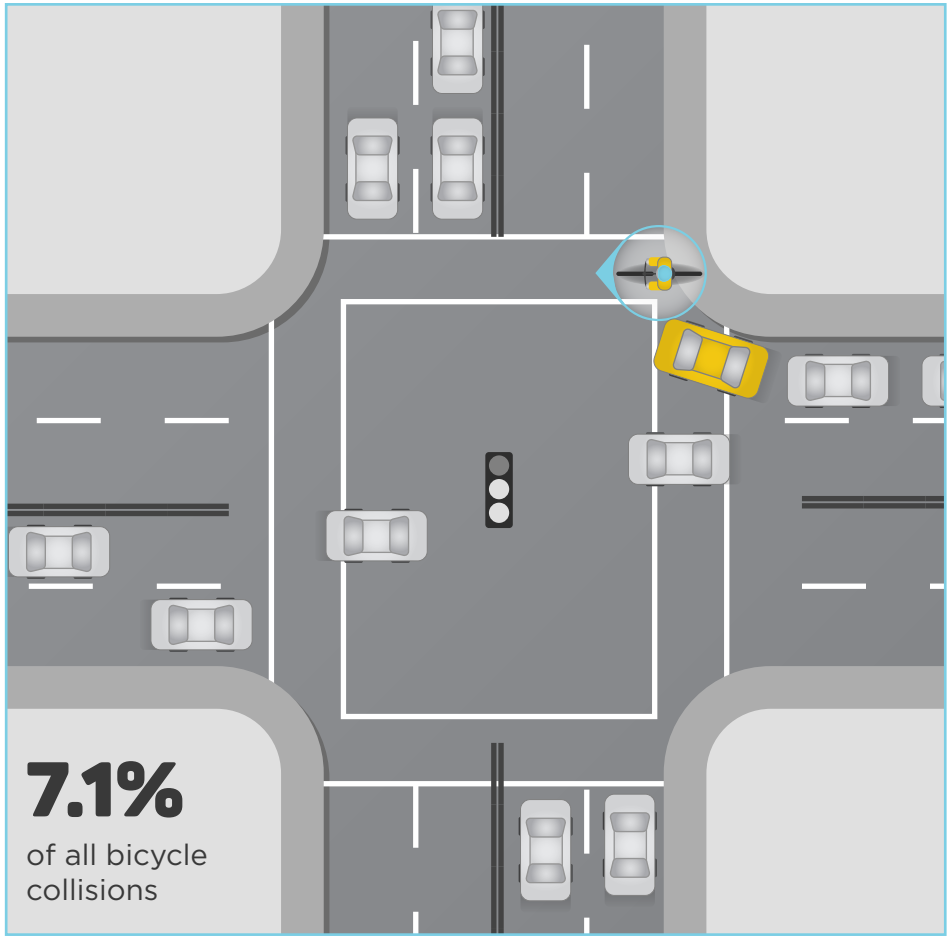
- Ride predictably - Bicycles must follow rules of the road (obey traffic signals and stop signs)

Bicycle rode out at an intersection

People riding on the sidewalk must enter the roadway at intersections, where drivers do not expect them to be. Education and comfortable bicycle facilities that encourage bicyclists to ride on the street and with traffic can reduce the prevalence of this type of collision. This collision type is more common than it appears due to an inconsistency in how collision report forms are completed.

WHAT'S HAPPENING?

- Bicycle rides off the sidewalk into an intersection
- Unsignalized and signalized intersections are equally prevalent in the data for this collision type
- Some involve the bicycle entering the intersection off the sidewalk traveling the wrong way



SOLUTIONS

ENFORCEMENT

- Sidewalk riding enforcement

ENGINEERING

- Bike lane
- Protected bike lane
- Bicycle boulevard
- Road buffet
- Signal modifications

EDUCATION

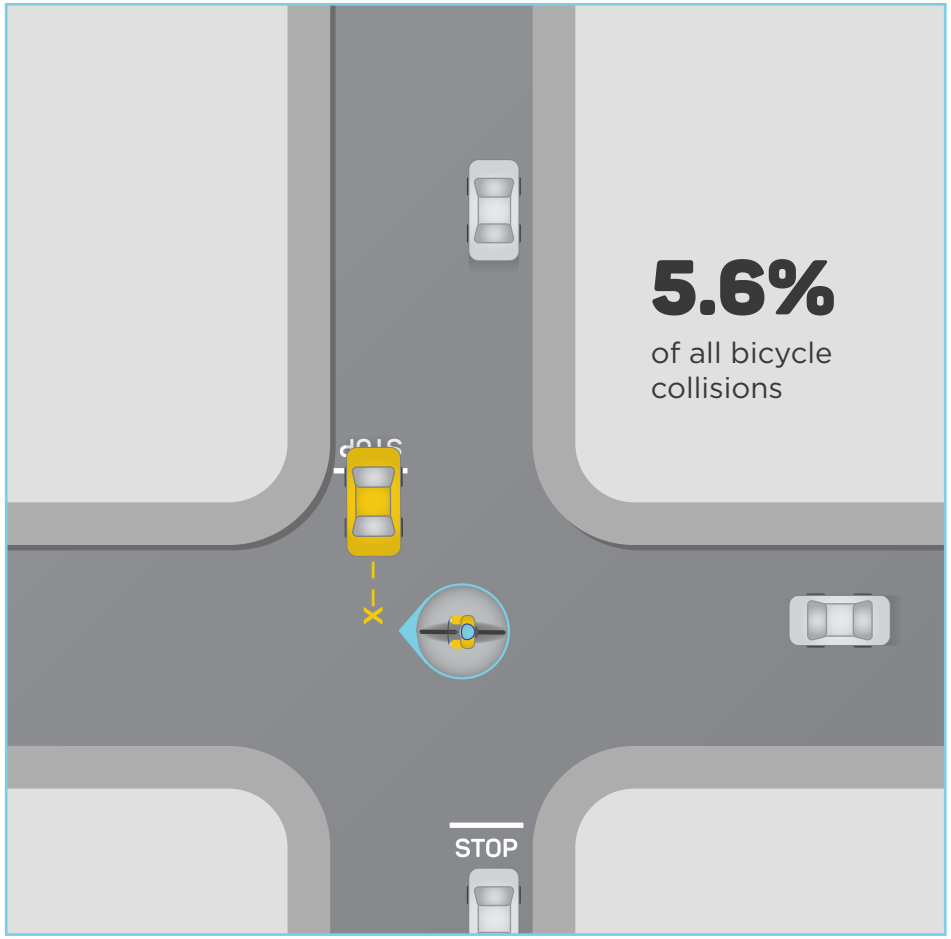
- Ride predictably - Sidewalk riding is dangerous
- Enter crosswalk at walking speed (and on right side of road) to avoid collisions with turning vehicles

Motorist failed to yield at an intersection

Drivers sometimes fail to notice bicyclists when rolling through a stop sign. Collisions of this type at signalized intersections are frequently hit and runs, which result in incomplete data but suggest that the driver ran the red light prior to hitting the bicyclist.

WHAT'S HAPPENING?

- Unsignalized and signalized intersections are equally prevalent in the data for this collision type
- Driver did not stop at a stop sign
- Driver had a green light but hit a bicycle at a signalized intersection that was legally completing its crossing



SOLUTIONS

ENFORCEMENT

- Traffic control enforcement

ENGINEERING

- Road buffet
- Signal modifications
- Speed feedback signs
- Lane width reduction
- Advanced stop bar
- Bicycle boulevard

EDUCATION

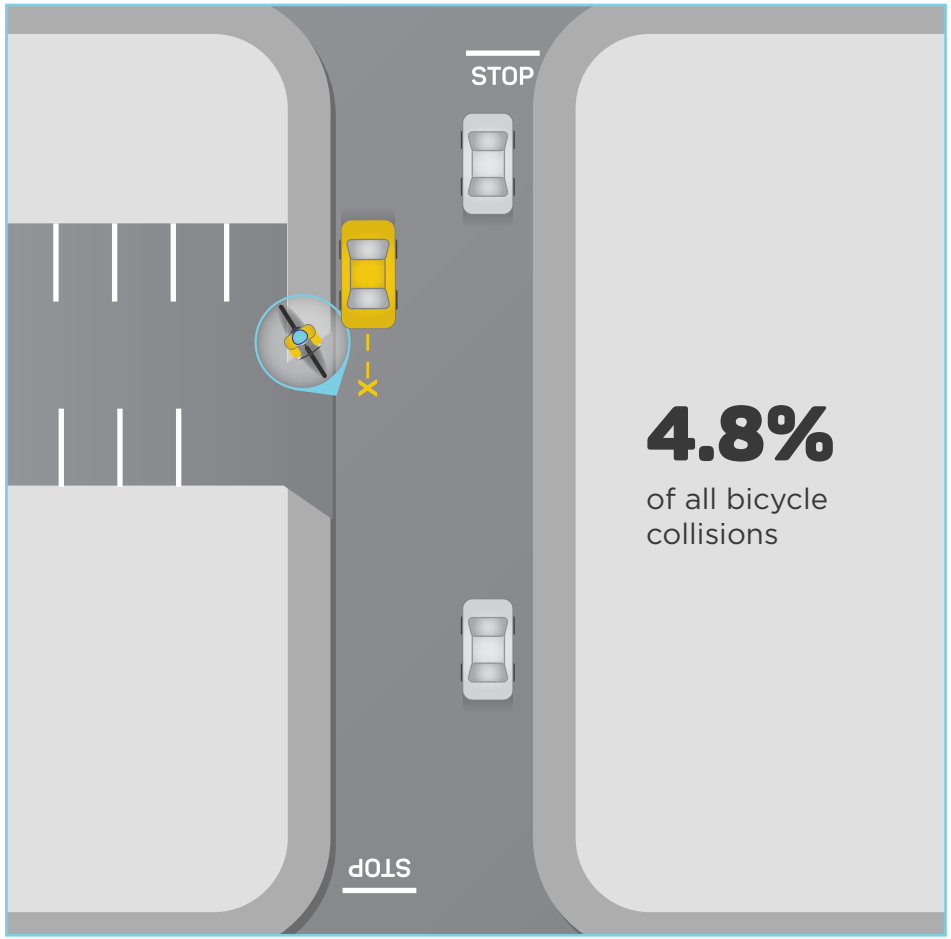
- Slow down for our kids
- Speed kills campaign

Bicycle rode out mid-block

Bicycle enters the roadway from a driveway and motorist didn't have time to avoid the collision.

WHAT'S HAPPENING?

» Bicycle pulled out of a driveway or off the sidewalk into the road and was struck by a vehicle that did not have time to avoid the collision



4.8%
of all bicycle collisions

SOLUTIONS

ENFORCEMENT

» Sidewalk riding enforcement

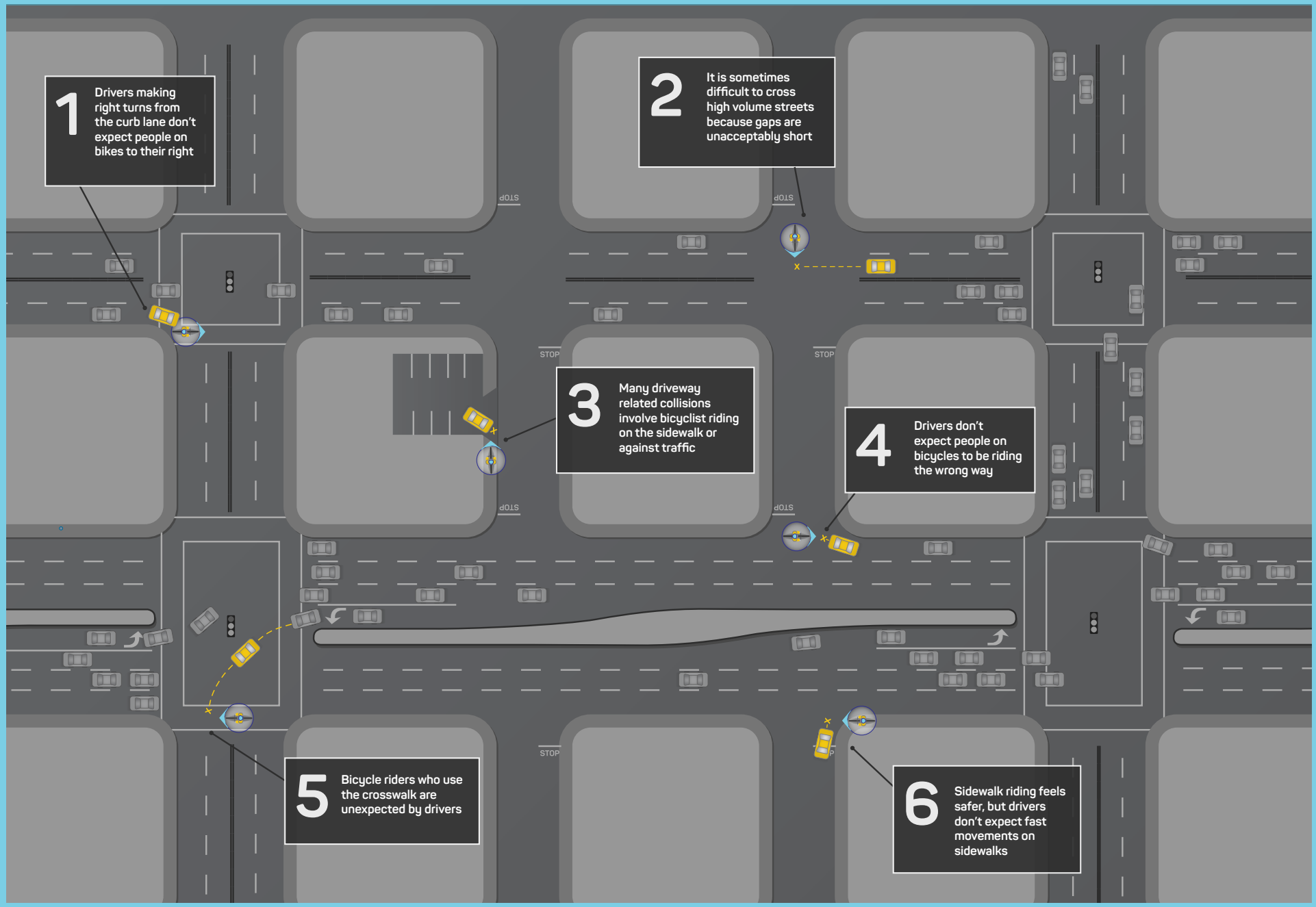
ENGINEERING

» Protected bike lane
» Bike lane
» Bicycle boulevard
» Road buffet
» Corridor access management

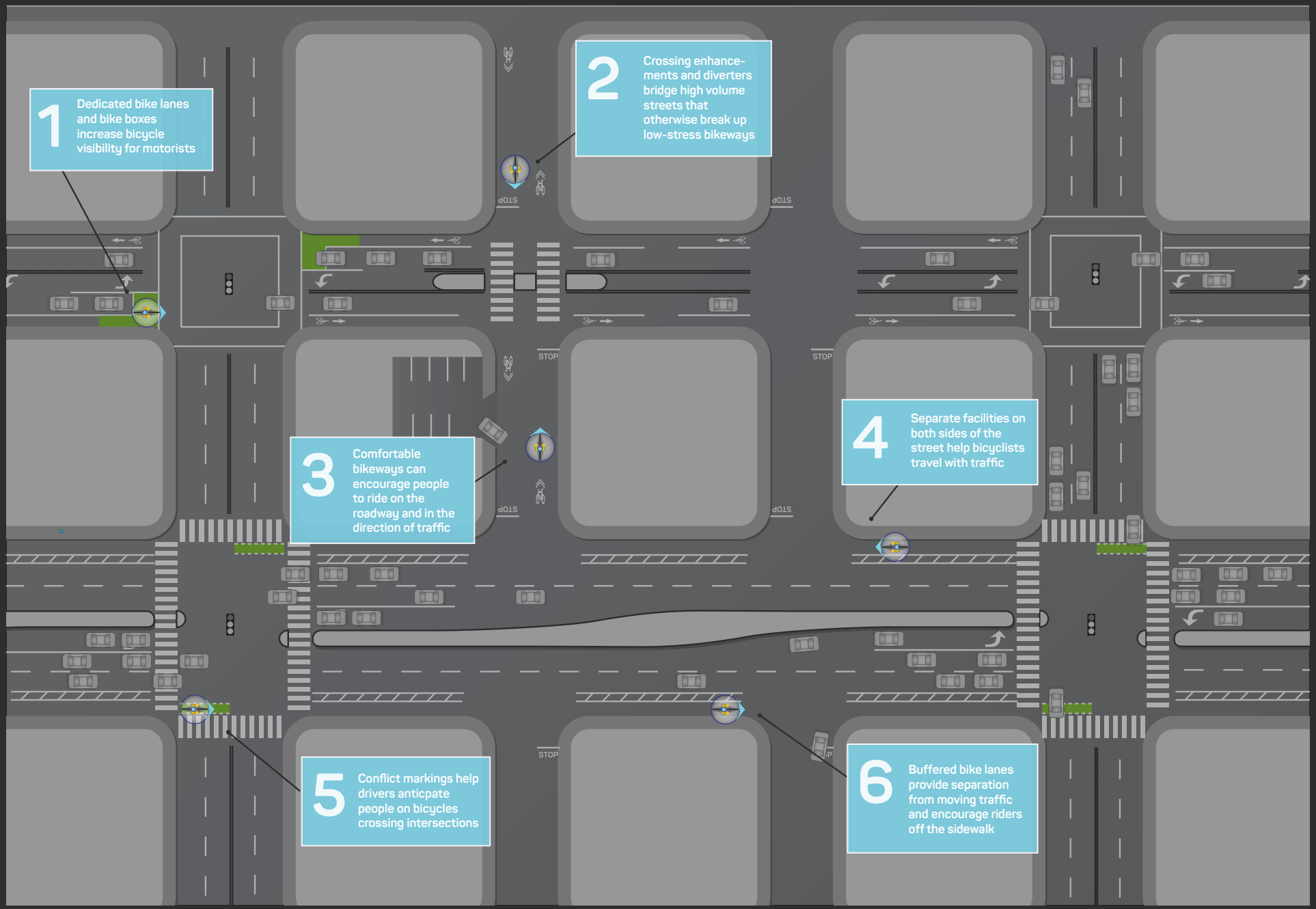
EDUCATION

» Ride predictably - Sidewalk riding is dangerous

TYPICAL COLLISIONS INVOLVING BICYCLES



SOLUTIONS TO COLLISIONS INVOLVING BICYCLES




Operational practices, policies, enforcement strategies, and campaigns will complement the physical investments to enhance safety.
Las mascotas de refugios de animales son súper mascotas

3 CITYWIDE SOLUTIONS

Santa Ana is taking a comprehensive approach to reducing collisions citywide, while focusing capital investments at high collision locations.

The Orange County Master Plan of Arterial Highways (MPAH) supports the following:

- **Goal 1:** Provide a Countywide Circulation (Arterial Highway) System to Accommodate Regional Travel Demand
- **Goal 2:** : Provide an Arterial Highway System that Supports Land Use Policies of the County and Cities

These goals can conflict with local policies around safety, as is the case in Santa Ana, where policy makers and staff support the introduction of safety countermeasures to reduce traffic collisions as a priority.

The Countermeasure Toolbox describes recommended roadway and intersection safety countermeasures for specific projects and ongoing use.

OCTA collaboration will be required for the installation of treatments that might reduce the number of vehicle travel lanes on an MPAH roadway or affect the ability of that travelway to accommodate existing and future traffic volumes. Although most countermeasures are subject to MPAH requirements, OCTA Board consideration may be possible for exceptions due to the documented safety concerns described in this plan.

A potential outcome of this collaboration could be increased flexibility for local jurisdictions throughout the county to implement additional types of safety improvements.

The steps for significantly changing MPAH roads are likely to include OCTA negotiations, grant applications, and design and construction.

Some capital projects will involve multiple agencies and/or require significant external funding, and may not be on the ground for 5-7 years. With this in mind, the City is taking a comprehensive approach to making streets safer for all users through immediate implementation efforts, including changes in operational practices and policies, additional enforcement, and the initiation of safety campaigns.

Operational Practices

Changes in the way everyday decisions are made by various City departments can help elevate pedestrian and bicycle safety. These changes are accomplished by considering the potential consequences of transportation, maintenance, enforcement, and land development decisions on people who walk and bicycle.

In addition to policy changes recommended in the following chapter, this section recommends operational strategies to reduce top speeds, and decrease the incidence and severity of collisions.

STREET MAINTENANCE

Right-of-Way and traffic signal maintenance protocols should include a summary of safety countermeasures in effect and a review by traffic operations to recommend new countermeasures. Examples include lane narrowing and high-visibility crosswalk markings during pavement maintenance projects.

CAPITAL PROJECT DELIVERY

- ☐ Develop a project delivery process and charter that requires the input of planning, police, transit, and public works in capital improvement project delivery, from concept to construction.
- ☐ Conduct a 'Complete Streets' review of projects in the Capital Improvements Program (CIP).

TRAFFIC SIGNAL MAINTENANCE

Long signal cycles create delay for all users, but for people who walk or bicycle, the delay can be even longer, if they arrive at the end of a cycle or have not been detected. In addition to complying with Caltrans Directive 09-06 on the implementation of AB1581 (which requires all signal projects to include approved bicycle signal detection strategies), bicycle detection and clear pavement markings to show the correct place to wait should be installed at all traffic signals.

Including pedestrian recall (walk signal occurs every cycle without requiring pedestrian to push a button) at high demand locations where the green phase will be unaffected by the call to the controller may reduce the number of people who cross without the benefit of the "WALK" signal. During annual signal inspections, intersections should also be considered for leading pedestrian intervals, which give pedestrians a few second head start to claim the right-of-way ahead of turning traffic.

TRAFFIC OPERATIONS

- ☐ Utilize 5 mph reductions in speed limit setting in areas with safety concerns and on street segments with existing and expected pedestrian activity.
- ☐ Utilize reduced speed limit setting opportunities in accordance with AB 73 in school zones, as appropriate.
- ☐ Reduce design speed controls by narrowing lanes to 10' during pavement maintenance and capital project design.
- ☐ Implement periodic data collection of 85th percentile speeds to monitor the effect of roadway changes.
- ☐ Utilize semi-permanent strategies, such as bollards, in order to get safety projects installed in the short term.

Policies

The successful implementation of this plan requires strong policy direction that supports the challenging decisions in front of elected officials and City staff. In adopting this plan, it is recommended that the Council move forward polices into the Circulation Element that reconsider the importance of congestion management and emphasize safety. The recommended polices are below.

RECONSIDER THE IMPORTANCE OF CONGESTION MANAGEMENT

- ☐ Adopt Alternate Mobility Standards that support lower levels of service without requiring capacity-enhancing mitigations or threatening OCTA funding.
- ☐ Substitute Transportation Demand Management mitigations to reduce vehicular trip generation in instances where capacity mitigations would degrade the quality or threaten the safety of people walking or people on bicycles.
- ☐ Work with OCTA to evaluate the reclassification and potential removal of high collision corridors from the Master Plan of Arterial Highways, in the interest of installing safety improvements that reduce travel lane width and intersection size.
- ☐ Prioritize safety improvements in Pedestrian Opportunity Areas.
- ☐ Utilize proactive urban street design strategies such that target speeds and design speeds are equivalent.

During the period of this study, red light running camera enforcement was in place. This program had documented success in reducing red light violations and collisions attributable to red light running. Consider monitoring red light collisions and reinstating the program, if they increase over time.

PRIORITIZE TRAFFIC SAFETY

- ☐ Establish safety coordinator position within Public Works Agency to carry out the actions within this plan.
- ☐ Adopt a vision of traffic safety that requires all daily operations to include organizational, practical, and cultural decisions that place the safety of roadway users as paramount.
- ☐ Adopt a Complete Streets policy and hierarchy that prioritizes people who walk, take transit and bicycle. Consider the recommendations provided by Orange County Council of Governments in the Orange County Complete Streets Initiative.
- ☐ Explore the benefits of a street typology system that guides the selection of street elements that support the desired character of the street based on its combined land use context and roadway function.
- ☐ The most protective bikeway solution should be assumed for new projects, with an exemption process that considers whether transit, land use, drainage, parking, circulation, or utility constraints prohibits it.
- ☐ Dedicate resources to the immediate implementation of projects in this plan.
- ☐ Dedicate resources to hire additional Police Department staff to implement the enforcement elements of this plan.
- ☐ Dedicate capital improvement funding for citywide projects that can be completed through work orders and reallocation of staff resources including: pedestrian refuge islands, rapid flashing speed feedback signs, and other relevant countermeasures as they become available.
- ☐ Require all roadway resurfacing projects and land development projects be circulated through a comprehensive process that takes into consideration: narrow lanes, road buffet, and other opportunities.

REDUCE SPEEDS

- ☐ Increase the size of the downtown area in the General Plan.
- ☐ Conduct a study of city streets and their land uses to determine if Prima Facie Residence and Business District speed limits of 25 mph might be applicable on streets where speed limits are currently established using Engineering and Traffic Surveys
- ☐ Utilize reduced speed limit setting opportunities by establishing prima facie speed limits of 25 mph in business, residential, and senior center areas, as appropriate.

UTILIZE DESIGN STRATEGIES THAT SUPPORT A HIGH QUALITY ENVIRONMENT FOR VULNERABLE ROADWAY USERS

- ☐ Prioritize transportation investments that support the reduction of health and wealth disparities in Santa Ana.
- ☐ Require collision history be included by Public Works Agency as a standard element of land development and capital improvement project development.
- ☐ Utilize design vehicles that represent frequent users of the street, rather than the largest possible vehicle, to improve the pedestrian environment.
- ☐ Revise corner curb radius guidelines to accommodate each street's design vehicle and recognize strategies for accommodating less frequent control vehicles such as very large trucks.
- ☐ Apply locally relevant aesthetic design considerations to right of way improvements.
- ☐ Incorporate water retention and percolation strategies in street improvement projects.
- ☐ Develop local Marked and Enhanced Crossing Guidance.
- ☐ Incorporate the Safe Mobility Santa Ana Proposed Active Transportation Network map into the Active Transporation Plan (see Chapter 5).

Enforcement

The infrastructure investments recommended in this plan will take time to design and construct, while immediate investments in enforcement and safety campaigns can result in citywide near term success. This chapter and its recommendations are informed by interviews with Santa Ana Police Department Traffic Division and Records staff, analyses conducted in the Safe Mobility Santa Ana study, an enforcement best practices review, and interviews with peer agencies that provide lessons learned. Detailed notes from each of these sources are included as technical appendices.

IN WHAT WAYS CAN COLLISION REPORTING, DATA MANAGEMENT AND DATA ANALYSIS IMPROVE?

The collision types defined in this plan were the result of careful consideration of the party and collision information, such as the movements preceding the collisions involving vulnerable roadway users. Although the result brings clarity to the current situation, annual reporting at this level will be difficult without changing some things about the collision reporting process—from the in-the-field data collection to annual traffic safety studies.

LIMITATIONS

In general, Santa Ana collision data are very high quality, with little post-processing of the Crossroads database required to understand collision and party information. However, limitations in CHP Form 555 make it difficult to easily describe collision types. Refinements to the reporting process would reduce this ambiguity. Taking swift action to improve the collision reporting and data input process will result in an improved database that is useful for informing appropriate safety countermeasures and simplifying the evaluation of progress over time. Limitations in the database, which make it difficult to understand the precise nature of some pedestrian and bicycle collisions, include:

- ☐ Inability to determine whether a person on a bicycle was on the sidewalk, traveling against traffic, or using the crosswalk prior to the collision
- ☐ Difficulty determining when motorists or people on bicycles are entering traffic via a driveway
- ☐ Lack of information on party distraction and Hit and Run collisions in the database exported to Public Works

The Public Works Department uses collision data to select locations that would be suitable for safety countermeasures, based on repeating collision patterns. There are several factors that limit the ability of these staff to conduct this monitoring:

- ☐ Public Works does not have direct access to collision database
- ☐ The labor cost of understanding collision data is high, relying on interpretation of vehicle code violations and often requiring reference to the narrative
- ☐ Collision context is difficult to ascertain because local roadway, traffic control and land use data are not joined to the file

SOLUTIONS

These limitations justify a need to make some changes in standard operating procedures regarding the life cycle of a collision. These changes will make it easier to understand collision patterns in the future. The practical changes recommended for data entry, data management, and analysis include:

- ☐ Supplementing the CHP Form 555 with local data entry that captures the attributes described above
- ☐ Standardizing practices and conducting officer training
- ☐ Provide Public Works with direct access as part of new Santa Ana Police IT system
- ☐ Increasing collaboration between police and public works staff
- ☐ Developing an integrated database that joins geocoded collision data to other relevant data sources and utilizes the collision typing developed in this plan to report changes over time.

These changes will provide opportunities to better understand and track collision patterns as they change over time, through more efficient collision reporting and clear data management and analysis strategies. They require increased communication and collaboration among the police and public works departments. Detailed descriptions of how to implement these solutions are provided in an Enforcement Technical Memorandum.

How can the police play a bigger role in preventing collisions through education and enforcement?

The Police Department is integral to the prevention of collisions through safety education, directed patrols, and enforcement of violations.

LIMITATIONS

Current staffing resources prevent creative community oriented policing around traffic safety because of other duties, namely collision reporting. The challenges identified through this study include:

- ☐ The large number of collisions in Santa Ana leaves insufficient time for enforcement or education
- ☐ There is no formal coordination of collision analyses and enforcement strategy
- ☐ Red light violations are likely to increase with removal of red light camera program

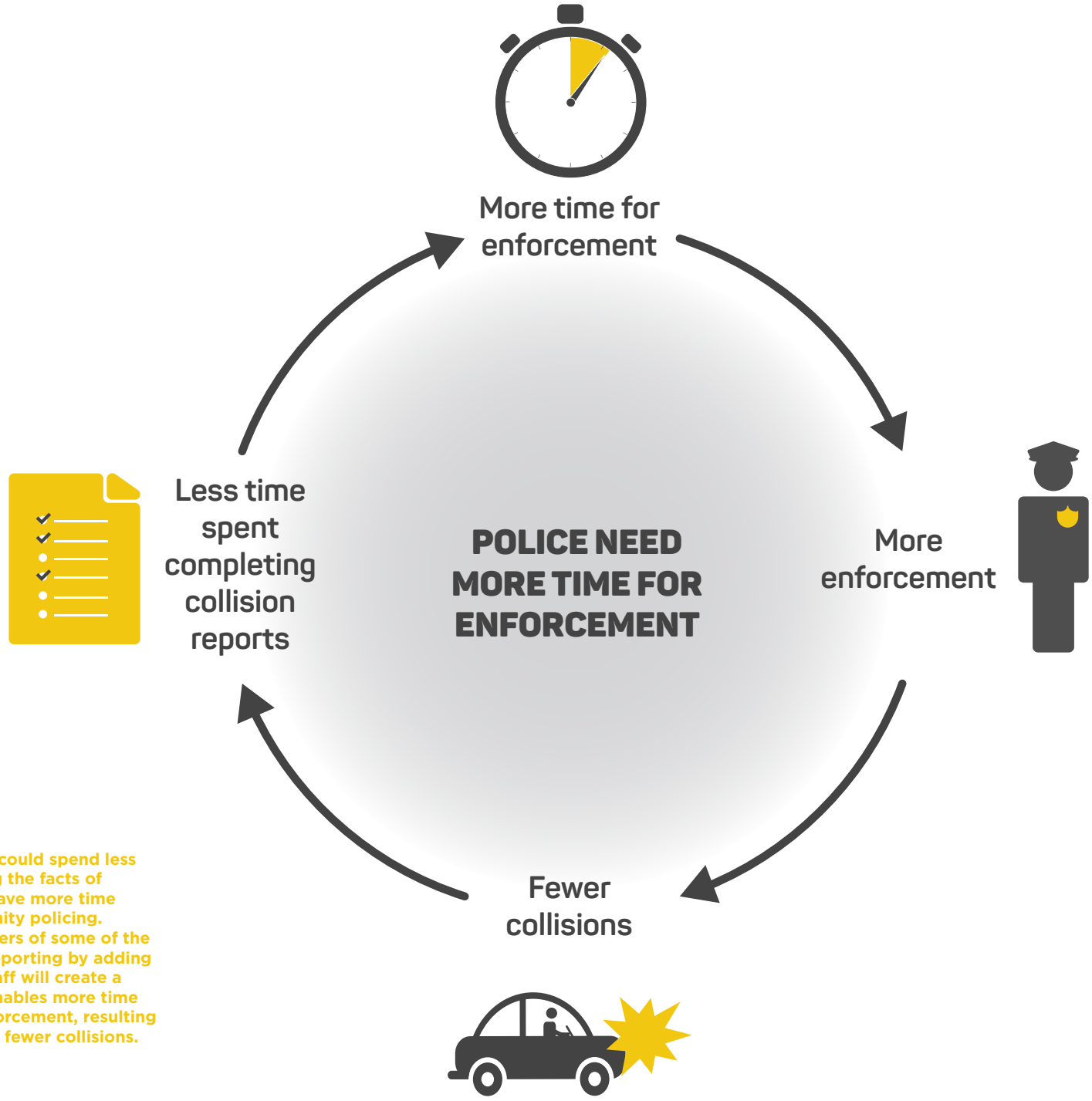
SOLUTIONS

The predominant vulnerable roadway user collision types must be the basis for prioritizing Santa Ana Police Department education and enforcement strategies. Furthermore, creative directed patrols and enforcement strategies should be funded with additional staff resources.
The education activities that are anticipated to have the largest impact include:

- ☐ Hire additional officers to support increased traffic enforcement and participation in safety and education campaigns
- ☐ Include traffic safety campaign outreach as part of community policing efforts
- ☐ Focus distribution of safety and enforcement information on high collision corridors and on streets with on-street bicycle facilities
- ☐ Increase opportunities for informal interactions in the community, including distributing safety campaign information related to high risk behaviors such as sidewalk and wrong way riding or initiating street crossings with insufficient time
- ☐ Increase community awareness of the prevalence and consequences of hit and run collisions to the driver to reduce the amount of collision records with incomplete information

The enforcement activities that are anticipated to have the largest impact include:

- ☐ Freeing up officer patrol time by hiring civilians to conduct and enter collision reports
- ☐ Increasing presence on high collision locations throughout the day, including targeted crosswalk enforcement
- ☐ Conducting routine enforcement of stop sign, wrong way, and crosswalk violations for all roadway users during regular patrols citywide
- ☐ Due to the lack of facilities, and the disproportionate impact moving violations have on the poor, a ticket diversion program must accompany increased levels of enforcement (an Enforcement Technical Memorandum provides a sample development and implementation process for a Santa Ana traffic diversion program)



If Santa Ana officers could spend less time on documenting the facts of collisions, they will have more time available for community policing. Relieving patrol officers of some of the burden of collision reporting by adding civilian and patrol staff will create a virtuous cycle that enables more time for visible police enforcement, resulting in more citations and fewer collisions.

Safety Campaign

Education is an essential element of improving roadway user safety. Roadway safety is achieved through a combination of supportive infrastructure and education on appropriate behaviors, followed up with enforcement. Cities across the country utilize education to increase knowledge of the rules of the road and positively influence various roadway user behaviors that contribute to collision frequency and severity. This section identifies messages appropriate to influence behaviors that contribute to collision patterns in Santa Ana, as well as appropriate audiences and media for their delivery.

MESSAGES

What messages can positively influence roadway user safety in Santa Ana?

Locally relevant messages that target specific unsafe behaviors in Santa Ana can provide the basis for a campaign that reduces the number of collisions involving nonmotorized transportation users. The messages on the next page were developed based on a review of safety messaging campaigns in other cities and the analyses of vulnerable road user collisions in Santa Ana.

SCAG's gohuman campaign provides people in the region with useful and easily understood public health and regulatory information.

gohuman
GoHumanSoCal.org

LET'S WALK

Go Human with your own two feet. Walking is one of the easiest ways to get active and stay fit. It's free, reduces stress, prevents disease, and connects you to your community in new ways.

Cross at the corner and use crosswalks when they're available.

Wait for the "Walk" signal before crossing. For walk signals with countdowns, don't enter the crosswalk if the hand is red.

Even if you have the right of way, look both ways. Make eye contact to be sure drivers see you.

Wear something bright or reflective when it's dark.

Want to know the secret to a happy life? Walking can reduce depression and anxiety. [1]

Walking 30 minutes a day can help reduce your risk of heart disease and stroke. [2]

Walking briskly can lower your risk of high blood pressure, high cholesterol, and diabetes as much as running. [2]

On average, a 20-minute walk can burn 100 calories! Where will you walk to instead of driving? [1]

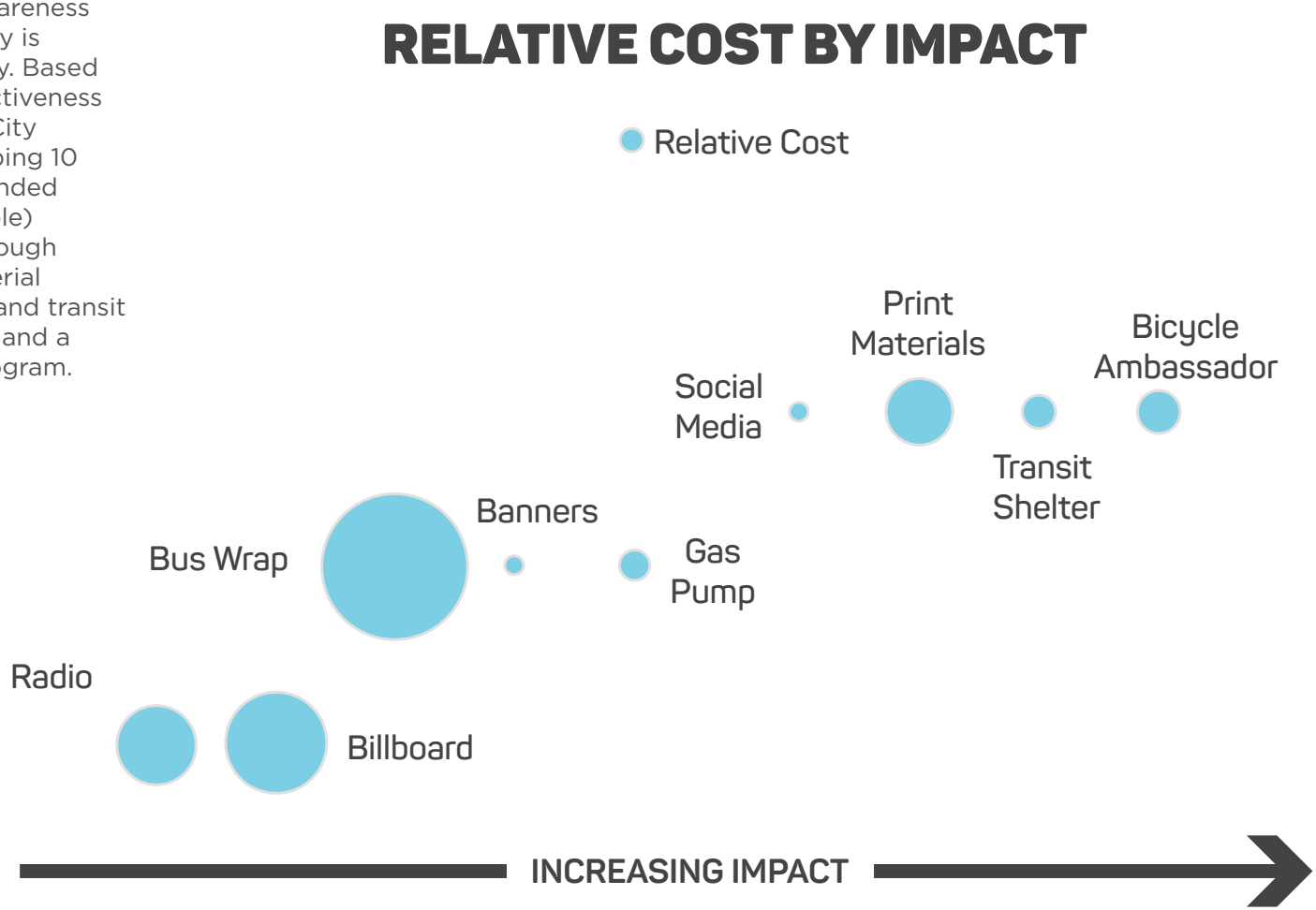
[1] NHTSA
[2] American Heart Association

50 YEARS SOUTHERN CALIFORNIA ASSOCIATION of GOVERNMENTS

SANTA ANA SAFETY MESSAGES	TARGET AUDIENCE
Targeted at Bicyclists	
Ride predictably - Wrong way riding is dangerous	» General bicycling population » Older youth/young adults
Ride predictably - Sidewalk riding is dangerous	
Ride predictably - Bicycles must follow rules of the road (obey traffic signals and stop signs)	
Enter crosswalk at walking speed (and on right side of road) to avoid collisions with turning vehicles	
Targeted at Pedestrians	
Look before crossing (even when you have the walk signal)	» Youth » General walking population
Cross at the corner - Remind pedestrians (including transit users) to utilize crossings/cross at intersections	» Transit users » Youth » General walking population
Targeted at Drivers	
Look in your blind spot (for bikes) before turning	» General driving population » Out of town motorists/regional travel
Yield to pedestrians in crosswalks (marked and unmarked)	
Slow down for our kids	
Speed kills campaign	
Gateway treatments when entering Santa Ana	» Out of town motorists/regional travel

CAMPAIGN IMPLEMENTATION TACTICS

As the physical landscape is slowly changing to support more walking and bicycling, a variety of tactics will be required to increase awareness that roadway user safety is everyone's responsibility. Based upon their relative effectiveness compared to cost, the City should invest in developing 10 locally relevant and branded messages (from the table) and distribute them through social media, print material distribution, gas pump and transit shelter advertisements, and a bicycle ambassador program.



COMMUNITY AND SCHOOL BASED EDUCATION

As we age from one to 100, our cognitive and physical abilities change. Younger people face decision making challenges brought on by the fact that their brains are still developing while older people experience ambulatory and cognitive changes that slow their ability to perceive, decide and act as quickly as when they were younger. Although infrastructure investments will benefit all Santa Ana community members, customized outreach to the very young and old is recommended.

EXISTING ACTIVITIES

Santa Ana, the Orange County Health Care Agency (OCHCA) and the Orange County Transportation Authority (OCTA) are currently providing safety messages in the schools and for the general community. These include night time riding videos, bus wraps and transit stop posters, and hands on education at the schools ranging from providing high visibility vests to teachers who greet students and teachers to in school education. OCHCA is providing education at the school site level, engaging youth in walk audits and planning activities. Walk to School Day annual activities were hosted at 14 Santa Ana elementary schools in 2015, and walking school buses and Drive Slowly lawn signs are being piloted. City Public Works staff conduct school assemblies by request at elementary schools and distribute Walking Safe coloring books. This work is complemented by pedestrian counts for crosswalk and crossing guard assessments, striping and other physical improvements. They also attend community events in 'conehead' outfits to teach how to walk safely. The curriculum is an internal source that was initially developed by the University of California, Irvine, in conjunction with the Moving Violators program.

RECOMMENDED ACTIVITIES

Develop revised school curriculum based on the key collision types occurring in Santa Ana. The curriculum should achieve the following:

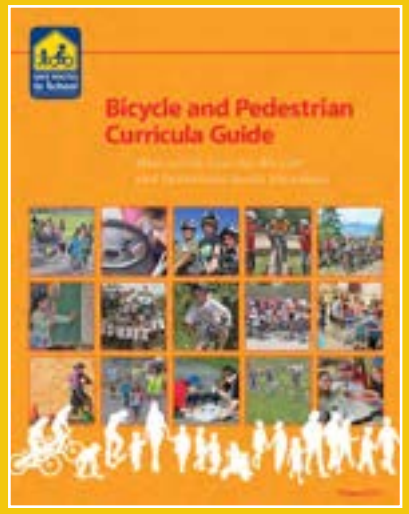
» **Accessibility.** Curriculum should be made available to school and City personnel. Curriculum must be approachable to a wide variety of teachers, and be made accessible through off-the-shelf Lesson Plans so that it can be taught regardless of staffing changes.

» **Content.** Curriculum should build on the current efforts and support the development of confident cyclists, better future adult drivers, and a culture of tolerance for alternative transportation. Curriculum needs to complement existing California state standards to gain widespread use by the school district. There are many existing education programs that could be modified for the Santa Ana context. A review of these programs for their ability to meet California Physical Education Standards and for their performance against criteria outlined by a local stakeholder committee is recommended. Curriculum and lesson plans should meet local goals related to sustainability, flexibility, California State content standards, and research-based best practices in health and physical education.

» **Format.** A ten lesson traffic safety curriculum with targeted behavioral outcomes aligned to state content standards, with scoring rubrics for assessments would be a meaningful addition to current school and community based education efforts. Ideally the District supports at least two points of instruction, in elementary school assemblies or classrooms and middle school on-bike training.

» **Implementation**. In addition to developing and test-teaching the curriculum, dedicated human resources to deliver it, supplies and logistics, and the process for scheduling need to be institutionalized in the regular operations of the City or a contracted provider. Schools face incredible demands on their time, and pressure to optimize instructional time. Regular marketing of the availability of an instructional program may be necessary to engage school administrators, teachers, staff, students, and parents in future instructional opportunities.

The Curriculum Guide produced by the National Safe Routes to School Partnership is a valuable resource for choosing the curriculum



http://saferoutespartnership.org/sites/default/files/pdf/Curr_Guide_2011_lo_0.pdf


Projects are targeted at locations
where collisions are occuring.
17th
ST
1200 W

4 RECOMMENDED IMPROVEMENTS

The Safe Mobility Plan identifies 37 corridor projects and 5 intersection projects as high priority for investment (many high collision intersections are included in the corridor projects).

This section describes how these priority projects were identified based on the collision analysis, followed by a map illustrating the project extents.

A detailed project table identifies project extents, elements, and costs. For many projects, the table provides a recommended and alternative (e.g. shorter implementation timeframe and/or suitable for an interim solution) set of project elements.

Project cut sheets (starting after page 63) were developed for the highest priority locations and include a detailed description of collision patterns and recommended solutions. These detailed sheets are intended to aid implementation and support grant applications. More detailed descriptions of the proposed projects are included in Appendix B: Project Tables.

A comprehensive list of recommendations that relate to operational practices, policies, enforcement practices, and education are provided in Chapter 3 (Citywide Solutions).

How were projects identified and prioritized?

High collision corridors and intersections were identified through a process that measured the density of collisions in close proximity to each other over the last ten years of available data. Fatal and severe collisions were weighted more heavily than other pedestrian/bicycle collisions. Vehicle only collisions received the lowest weight. This analysis resulted in 32 High Collision Pedestrian Corridors, 30 High Collision Bicycle Corridors, 25 High Collision Pedestrian Intersections, and 23 High Collision Bicycle Intersections.

These were refined into a list of projects as a high priority for investment as follows:

- Using the union of High Collision Pedestrian and Bicycle Corridors to define corridor projects as priority investment areas
- High collision intersections along high collision corridors were incorporated into the respective corridor projects, while those not along a high collision corridor are stand-alone intersection projects
- Projects were ranked by the total number of vulnerable road user crashes per mile.

PRIORITY PROJECTS

The above methodology resulted in 37 corridor projects and 5 intersection projects identified as high priority for investment (many high collision intersections are included in the corridor projects), which are illustrated in the map, with corresponding project numbers, on the following page.

Individual project sheets developed for over 30 projects are included at the end of this chapter. These project sheets are intended to support grant applications to get projects funded and implemented, and bring together a variety of relevant information in a graphical format, including collision patterns, recommended improvements, costs, and anticipated benefits.

A more detailed description of the elements involved in each project as well as other planning considerations are provided in a project table found in Appendix B. This table should be referenced during project implementation.

COMMUNITY SURVEY RESULTS REGARDING TOP TRANSPORTATION INVESTMENT CONSIDERATIONS

The selection of project solutions was informed by a community survey (Fall 2015) that helped the City understand priorities in making investments to enhance road user safety at the selected project locations.

Top transportation investment considerations

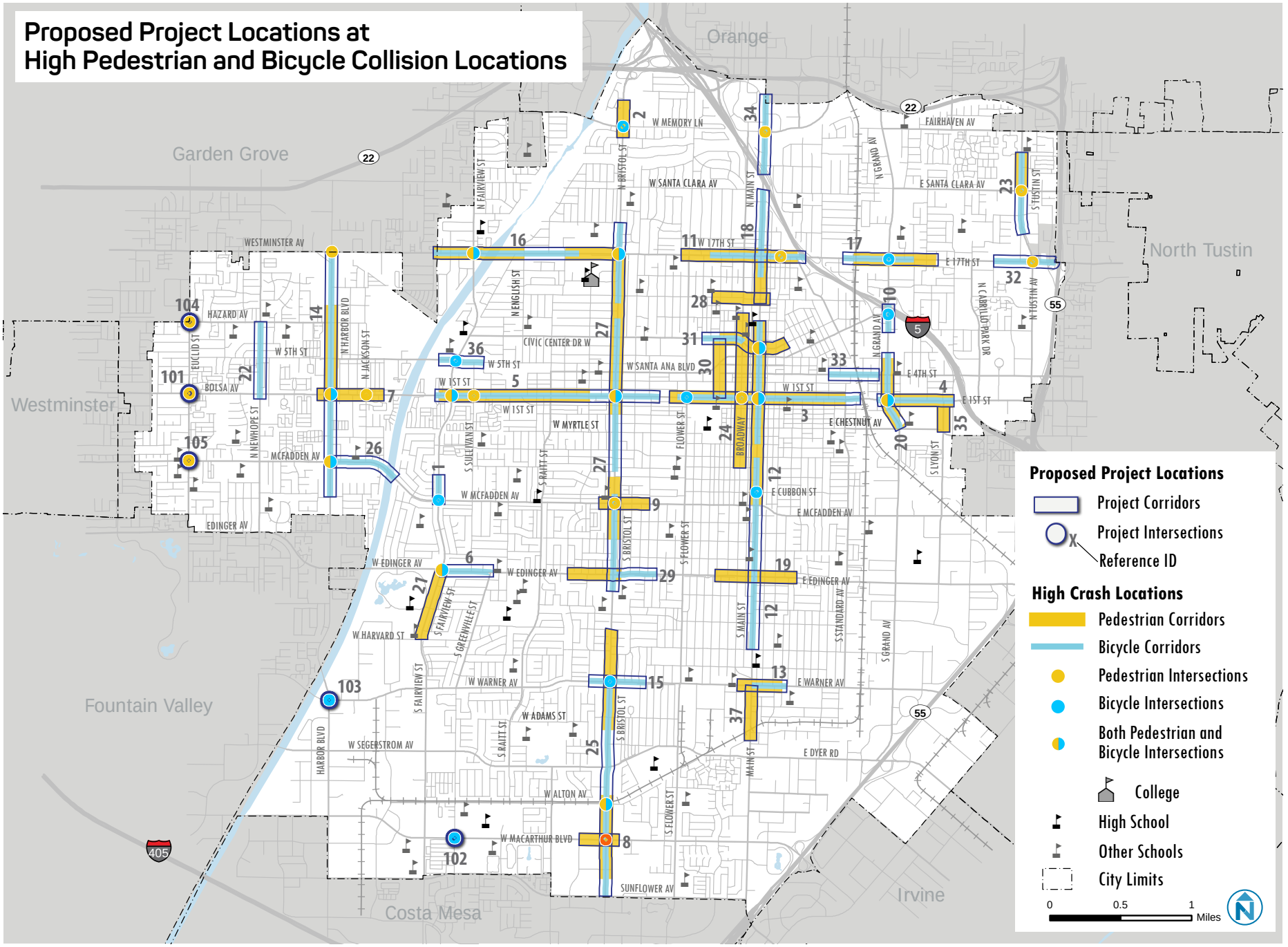
- Improving traffic flow
- Slowing down how fast people drive on the street
- Education/enforcement for people who bike, walk, and drive to increase courtesy and compliance with roadway rules
- Making it easier for people walking to cross the street

Pedestrian improvements respondents would like to see more of in Santa Ana

- Roadway lighting improvements
- Trails and pathways
- More traffic signals and flashing crossing beacons

Bicycle improvements respondents would like to see more of in Santa Ana

- Protected bike lanes
- Colored bike lanes
- Painted bike lanes
- Buffered bike lanes


Proposed Project Locations at
High Pedestrian and Bicycle Collision Locations
Orange
Garden Grove
Westminster
Fountain Valley
Costa Mesa
Irvine
North Tustin
W MEMORY LN
W SANTA CLARA AV
FAIRHAVEN AV
E SANTA CLARA AV
WESTMINSTER AV
HAZARD AV
BOLSA AV
MCFADDEN AV
EDINGER AV
W 5TH ST
W 1ST ST
CIVIC CENTER DR W
W SANTA ANA BLVD
W MYRTLE ST
W 17TH ST
E 17TH ST
E 4TH ST
E 1ST ST
E CHESTNUT AV
E CUBBON ST
E MCFADDEN AV
E EDINGER AV
W EDINGER AV
W HARVARD ST
W WARNER AV
E WARNER AV
W ADAMS ST
W SEGERSTROM AV
E DYER RD
W ALTON AV
W MACARTHUR BLVD
SUNFLOWER AV
N HARBOR BLVD
N JACKSON ST
N NEWHOPE ST
N ENGLISH ST
N FAIRVIEW ST
N BRISTOL ST
N MAIN ST
N GRAND AV
S TUSTIN ST
W TUSTIN AV
N CHARLOTTE PARK DR
S RAITT ST
S SULLIVAN ST
S FLOWER ST
S BRISTOL ST
S FAIRVIEW ST
S GREENVILLE ST
S MAIN ST
S STANDARD AV
S GRAND AV
S LYON ST
HARBOR BLVD
MAIN ST
BROADWAY
Proposed Project Locations
Project Corridors
Project Intersections
Reference ID
High Crash Locations
Pedestrian Corridors
Bicycle Corridors
Pedestrian Intersections
Bicycle Intersections
Both Pedestrian and Bicycle Intersections
College
High School
Other Schools
City Limits
0
0.5
1
Miles

WHAT IS A ROAD BUFFET?

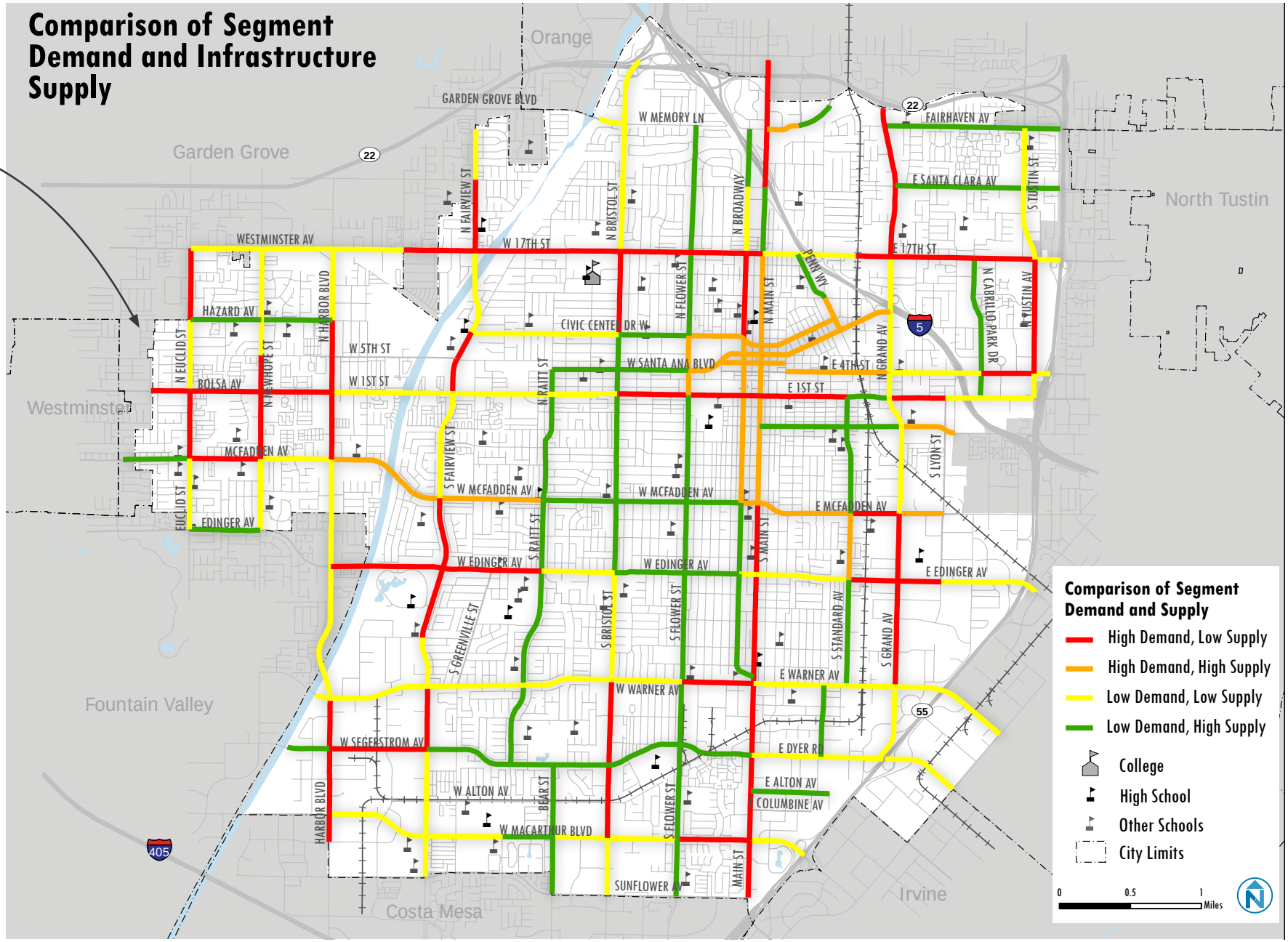
This plan uses the term Road Buffet to describe the re-allocation of roadway space to increase the variety of attractive transportation choices.

How did we determine the level of investment?

High priority corridors for investment were based on collision frequency. The intensity of investment to address the relevant safety issues was informed by an analysis that compared demand for walking and bicycling throughout the City of Santa Ana with the quality of the walking and bicycling environment based on factors that affect their actual and perceived safety such as speed and separation.

The analysis on this map illuminates areas where many people are expected to be, but where facilities are uncomfortable for walking and bicycling. The red segments illustrate areas where high demand and poor supply of infrastructure overlap. Safety countermeasures that are potentially most impactful but also require a greater level of investment and/or other tradeoffs were considered for these locations.

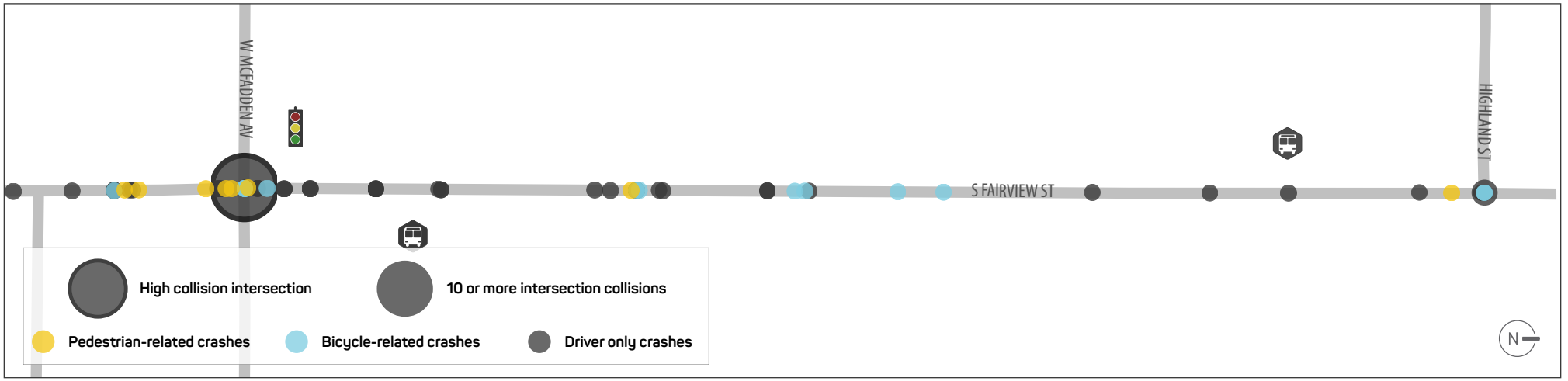
The analysis of project locations and recommended project countermeasures are defined on the cut sheets starting on page 64.



» The supply analysis considered roadway infrastructure characteristics that impact the ease and safety of pedestrian and bicycle travel, including factors such as the number of travel lanes, posted speed, AADT, and availability or lack of traffic control. The demand analysis includes factors such as proximity to schools, parks, transit stops, population density, and employment density.

01 | FAIRVIEW STREET FROM HIGHLAND ST TO S OF W MCFADDEN AVE

COLLISION HISTORY

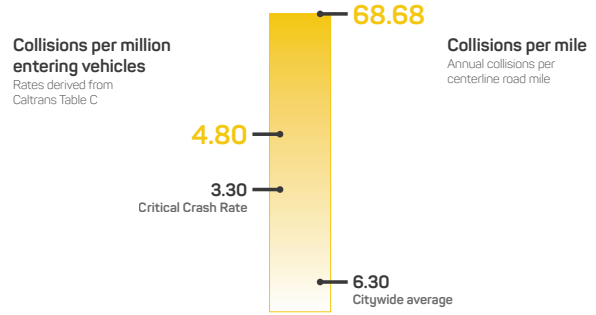


LOCATION DESCRIPTION

The distribution of bicycle collisions reflects activity along the east side of Fairview connecting high density residential near Highland to McFadden (and the # 47 bus line). Multiple driveways associated with commercial development represent potential points of conflict. McFadden is a high collision intersection for both pedestrians and bicyclists.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.21
Number of Lanes	6
ADT	39,200
Schools	-
Transit Lines	47
Major Generators	-

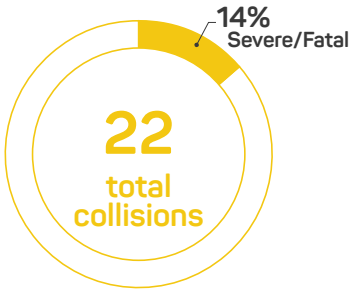
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	3	7
Signalized Intersection	4	5
Unsignalized Intersection	1	2
Total	**8**	**14**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

» Mix of mid-block and signalized intersections

Bicycle Collisions

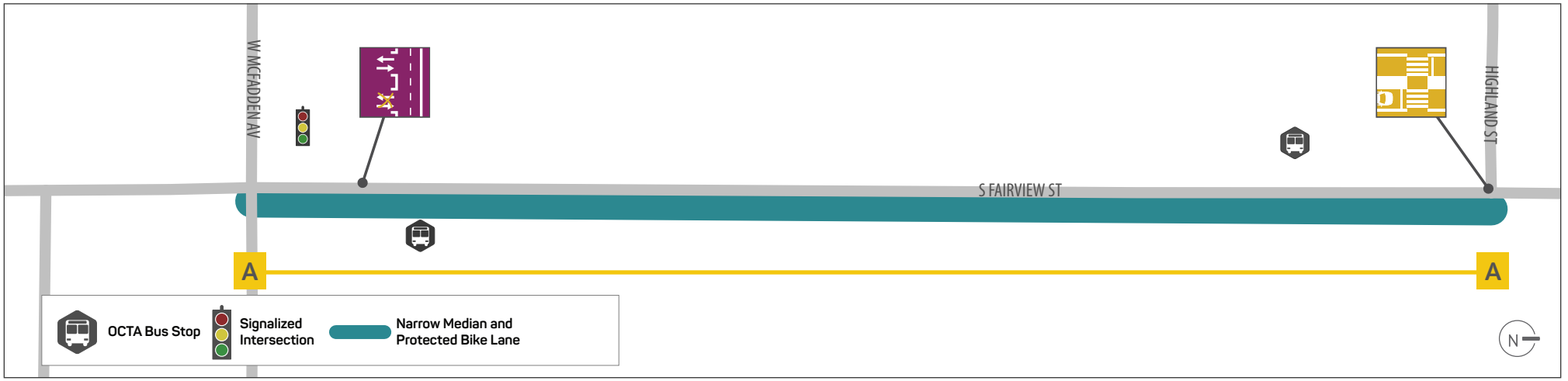
» Mix of mid-block and signalized intersections

» Wrong way riding

» Collisions at driveways

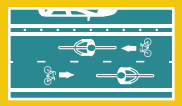
01 | FAIRVIEW STREET

SOLUTIONS

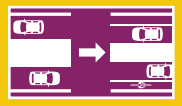


PROJECT DESCRIPTION

The recommendations respond to the prevalence of bicycle collisions between Highland and McFadden and both pedestrian and bicycle collisions at the intersection of Fairview and McFadden.


Two-way Protected Bike Lane


Median Refuge Island


Narrow Median


Driveway Consolidation

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$1,520,625

Corridor Access Management	$	19,500
Two-Way Protected Bike Lane	$	182,000
Median Refuge Island	$	30,000
Traffic Signal Modification	$	125,000
Median Narrowing	$	618,750
Curb and Gutter	$	38,500
Engineering Design	$	152,063
Construction Engineering	$	152,063
Contingencies	$	202,750

EXPECTED BENEFIT/COST RATIO

0.52

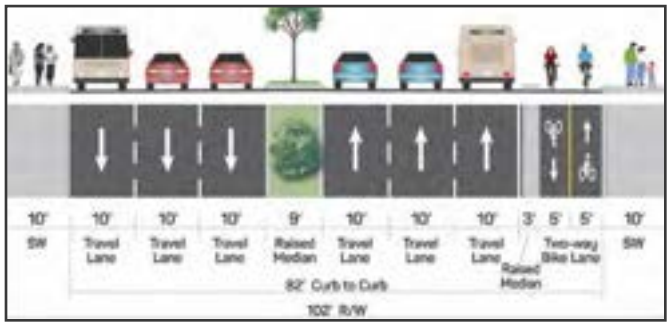
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

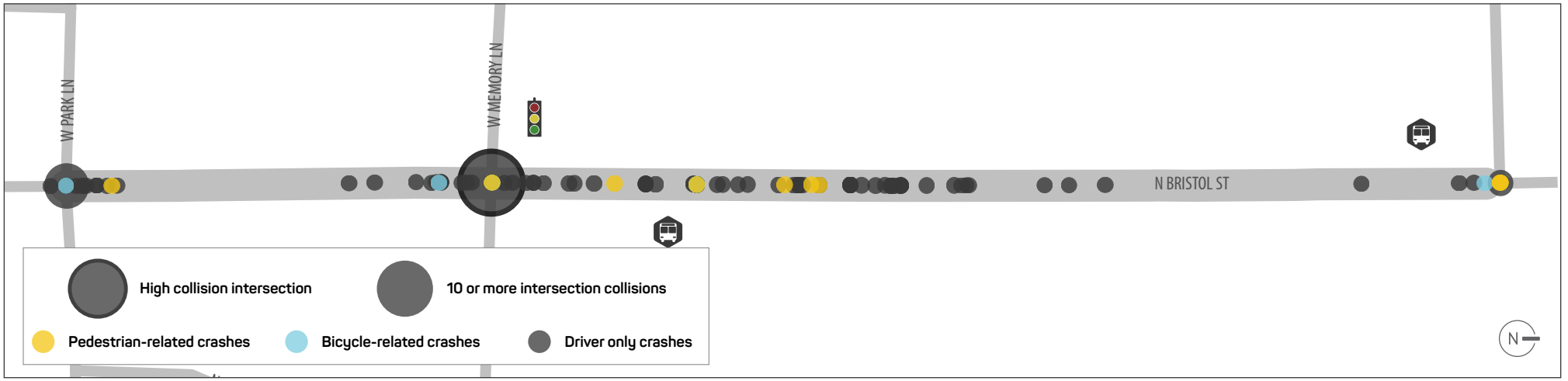
A



Note - Proposed cross section subject to change based on actual field conditions and engineering judgement.

02 | BRISTOL STREET FROM RIVERGLEN LN TO WEST PARK LN

COLLISION HISTORY

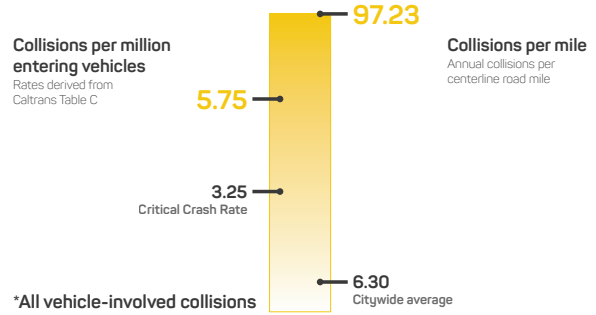


LOCATION DESCRIPTION

At the north end of the city, pedestrian and bicycle activity on Bristol is generated by residential land uses, the Bristol Village Plaza Shopping Center, as well as the #56, #57, and #757 bus lines.

Classification	Major Arterial
Posted Speed	45
Length (miles)	0.26
Number of Lanes	7
ADT	46,300
Schools	-
Transit Lines	56, 57, 757
Major Generators	Bristol Village Plaza Shopping Center

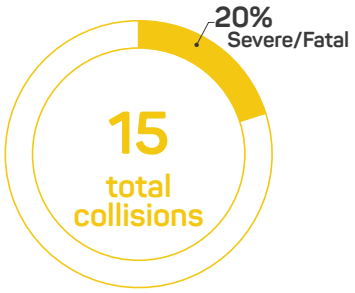
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	5	2
Signalized Intersection	4	2
Unsignalized Intersection	1	1
Total	**10**	**5**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

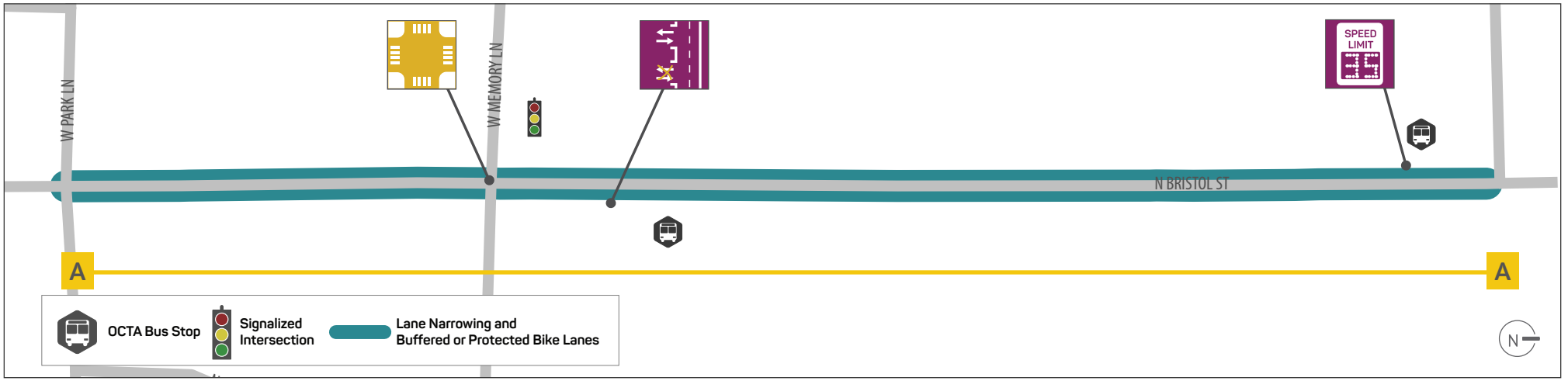
» Mix of mid-block and signalized intersections

Bicycle Collisions

» Mix of mid-block and signalized intersections

02 | BRISTOL STREET

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions at signalized intersections and mid-block along a corridor where out of town motorists enter Santa Ana. Elements include:

- Lane Narrowing
- Add Crosswalks
- Signal Syncronization
- Buffered or Protected Bike Lanes
- Driveway Consolidation
- Variable Speed Sign

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$849,600

Corridor Access Management	$	13,000
One-Way Protected Bike Lane	$	219,000
Marked Crosswalk	$	4,300
Signal and Speed Limit Modifications	$	253,100
Speed Feedback Sign	$	20,000
Median Narrowing	$	50,000
Curb and Gutter	$	7,000
Engineering	$	84,960
Fees/Permits/Supervision	$	84,960
Contingencies	$	113,280

EXPECTED BENEFIT/COST RATIO

16.22

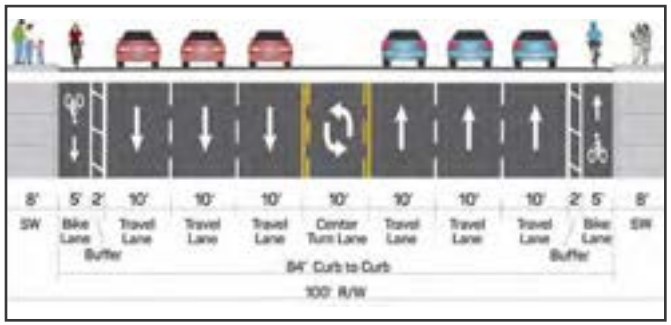
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

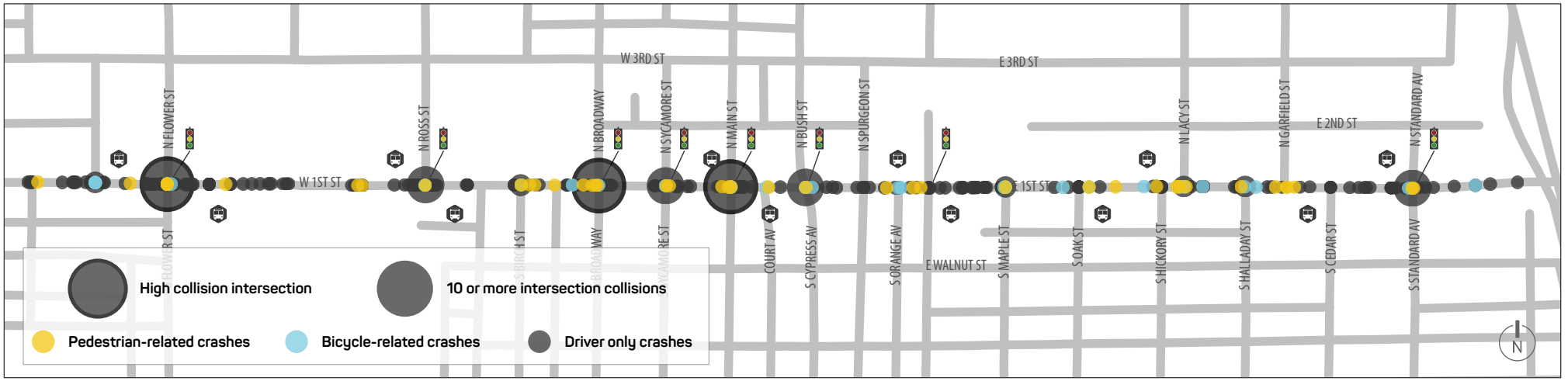
CROSS SECTIONS

A



03 | FIRST STREET FROM BOOTH STREET TO RAILROAD

COLLISION HISTORY

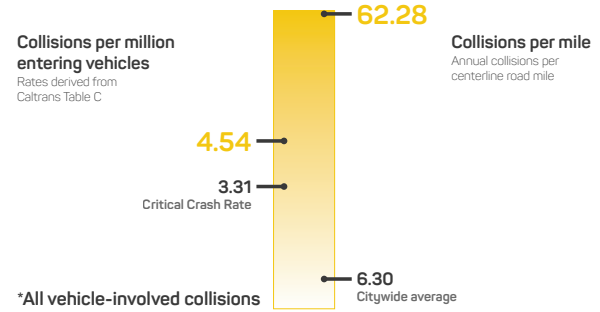


LOCATION DESCRIPTION

The distribution of pedestrian and bicycle collisions reflects activity associated with commercial development, proximity to downtown, and the #55 and #64 bus lines. Main (pedestrian and bicycle), Flower (bicycle), and Broadway (pedestrian) are high collision intersections.

Classification	Major Arterial
Posted Speed	40
Length (miles)	1.35
Number of Lanes	4 - 6
ADT	37,600
Schools	Santa Ana High School; Edward Cole Sr Academy
Transit Lines	55, 64
Major Generators	Fiesta Marketplace Shopping Center

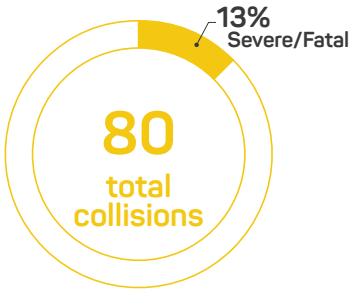
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	12	9
Signalized Intersection	16	17
Unsignalized Intersection	13	13
Total	**41**	**39**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

» Collisions occur throughout corridor at all location types (see above)

» Nearly 3/4 involve through vehicles

Bicycle Collisions

» Collisions occur throughout corridor at all location types (see above)

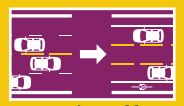
» Collisions with right turning vehicles

03 | FIRST STREET

SOLUTIONS

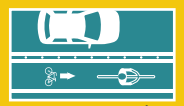
PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequent at all location types (signalized intersections, unsignalized intersections, and mid-block).


Road Buffet


Relocate Transit Stops


InstallI Traffic Signal


Protected Bike Lanes


Median Refuge Island

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$1,830,450

One-Way Protected Bike Lane	$	949,000
Retrofit Median Refuge Island	$	9,800
Traffic Signal	$	250,000
Transit Stop	$	11,500
Engineering	$	183,045
Fees/Permits/Supervision	$	183,045
Contingencies	$	244,060

EXPECTED BENEFIT/COST RATIO

22.15

Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

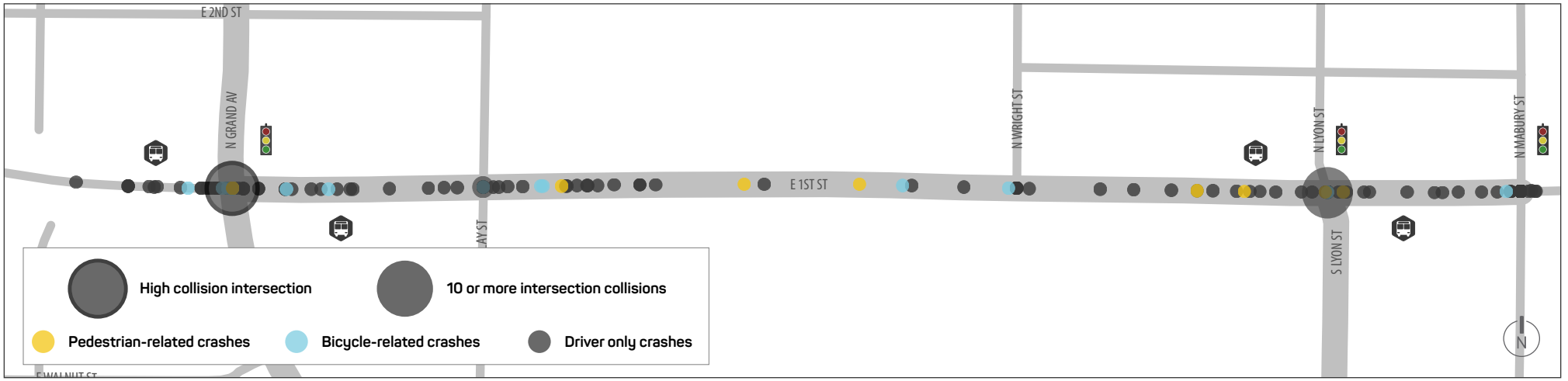
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

04 | FIRST STREET FROM HATHAWAY STREET TO I-5

COLLISION HISTORY

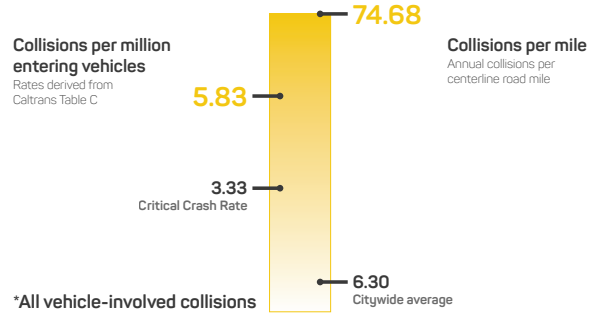


LOCATION DESCRIPTION

Between the railroad tracks and I-5, the distribution of bicycle and pedestrian collisions on 1st reflects a mix of commercial land uses, the #64 bus line, and a lack of parallel bike routes. Grand is a high collision intersection for both pedestrians and bicyclists.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.54
Number of Lanes	4 - 6
ADT	35,100
Schools	Raymond A Villa Fundamental Intermediate School
Transit Lines	64
Major Generators	Various commercial land uses

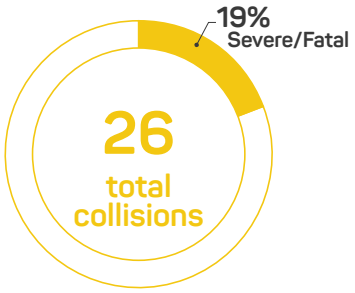
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	5	6
Signalized Intersection	5	8
Unsignalized Intersection	0	2
Total	**10**	**16**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

- Mix of signalized intersections and mid-block
- More than half involve through vehicles

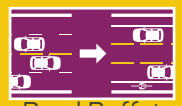
Bicycle Collisions

- Half at signalized intersections
- More than a third mid-block
- Driveways

SOLUTIONS

PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequent at signalized intersections and mid-block (including driveways for bicycle involved collisions). Elements include:



Road Buffet

Relocate Transit Stops

Buffered Bike Lanes

Signal Synchronization

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$534,600

Road Buffet (6 to 5 lanes)	$	91,000
Signal Timing Modification	$	3,900
Transit Stop	$	11,500
Traffic Signal Modification	$	250,000
Engineering	$	53,460
Fees/Permits/Supervision	$	53,460
Contingencies	$	71,280

EXPECTED BENEFIT/COST RATIO

40.35

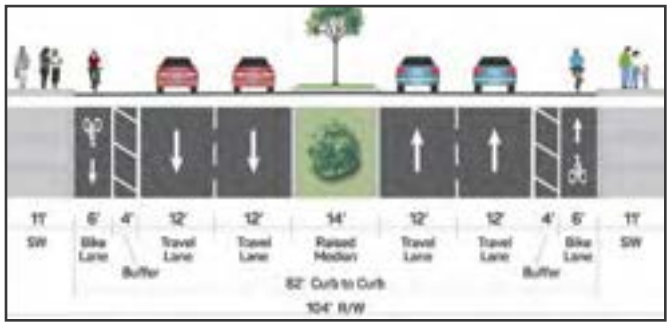
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

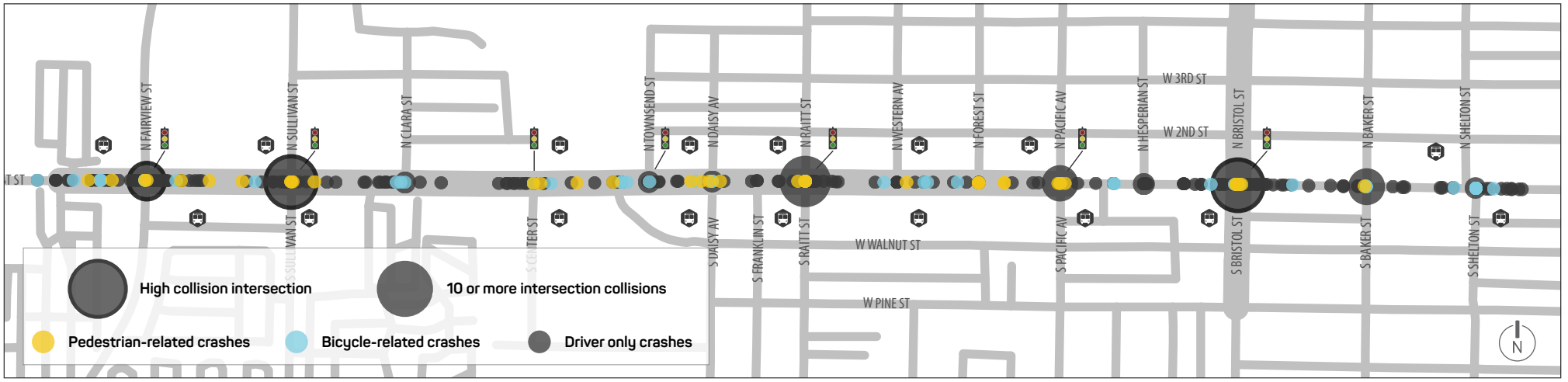
CROSS SECTIONS

A



05 | FIRST STREET FROM S MONACO DR TO W OF S SHELTON ST

COLLISION HISTORY

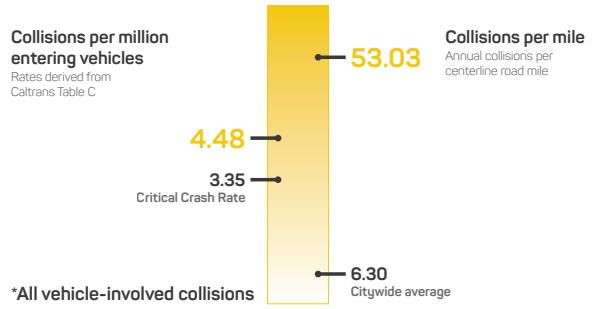


LOCATION DESCRIPTION

The distribution of bicycle and pedestrian collisions reflects activity associated with commercial development, the #64 bus line, and proximity to schools and downtown at its eastern end. Bristol (pedestrian and bicycle), Fairview (pedestrian and bicycle), and Sullivan (pedestrian) are high collision intersections.

Classification	Major Arterial
Posted Speed	40
Length (miles)	1.59
Number of Lanes	6 - 7
ADT	32,400
Schools	Lydia Romero-Cruz Elementary School
Transit Lines	64
Major Generators	-

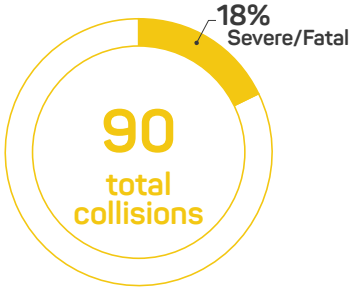
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	12	21
Signalized Intersection	21	16
Unsignalized Intersection	7	13
Total	**40**	**50**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

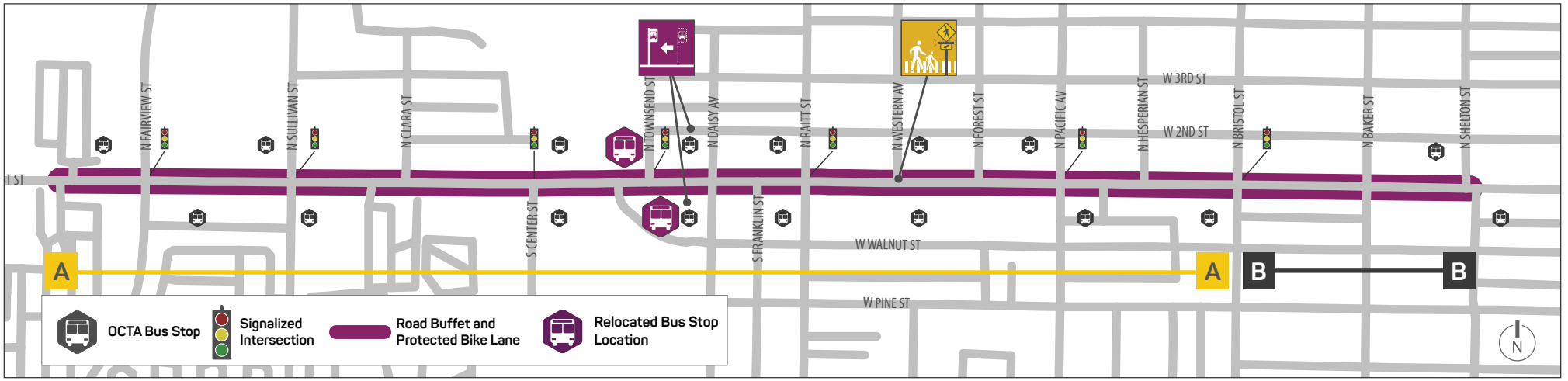
Pedestrian Collisions

- » Collisions occur throughout corridor
- » More than half at signalized intersections
- » Approximately one-third mid-block
- » Approximately 2/3 involve through vehicles

Bicycle Collisions

- » Collisions at all location types (see above)
- » Collisions at driveways

SOLUTIONS

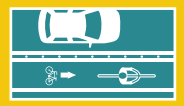


PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequent at all location types (signalized intersections, unsignalized intersections, and mid-block).

Road Buffet

Relocate Transit Stops



Protected Bike Lanes

Enhanced Crossing

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$4,188,900

One-Way Protected Bike Lanes	$	1,168,000
Rectangular Rapid Flashing Beacon	$	14,200
Roadway Lighting	$	30,000
Transit Stop	$	23,000
Traffic Signal Modification	$	250,000
Median (Narrowing and Installation)	$	980,000
Curb and Gutter	$	326,900
Engineering	$	418,890
Fees/Permits/Supervision	$	418,890
Contingencies	$	558,520

EXPECTED BENEFIT/COST RATIO

22.02

Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

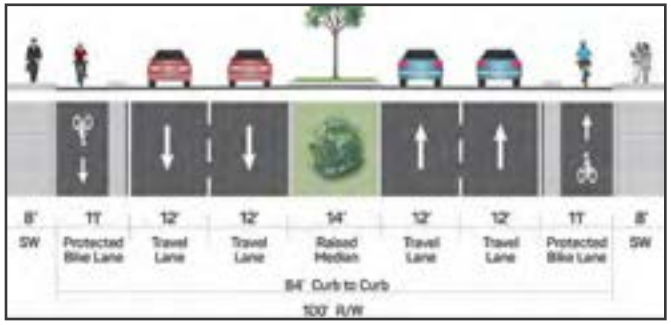
The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

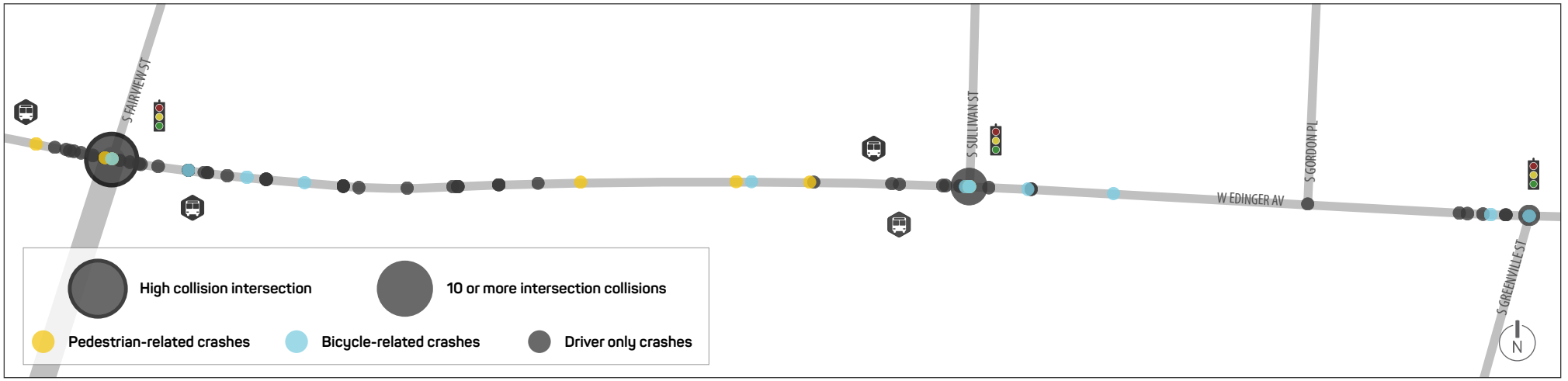
A

B



06 | EDINGER AVENUE FROM S FAIRVIEW ST TO CENTER ST

COLLISION HISTORY



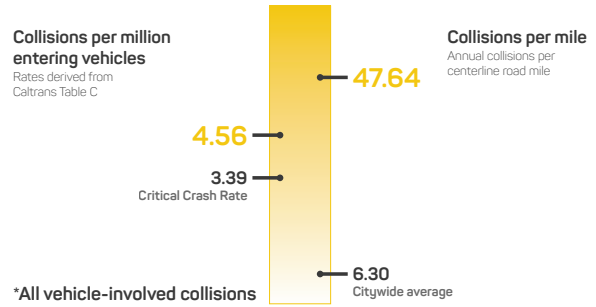
Note - The collision data reflected on this page corresponds to the high collision corridor identified in the analysis for the Safe Mobility Plan: Edigner Avenue from S Fairview St to S Greenville Street. The proposed project extent is larger than this corridor, extending from S Fairview Street to Center St.

LOCATION DESCRIPTION

The distribution of bicycle and pedestrian collisions on Edinger near the western edge of the city reflects activity generated by Centennial Regional Park, several schools, and the #70 bus line. Fairview is a high collision intersection for both pedestrians and bicyclists.

Classification	Major Arterial
Posted Speed	35
Length (miles)	0.46
Number of Lanes	6
ADT	28,600
Schools	Carl Harvey Elementary School; Diamond Elementary School; Valley High School; Gerald P Carr Intermediate School
Transit Lines	70
Major Generators	Centennial Regional Park

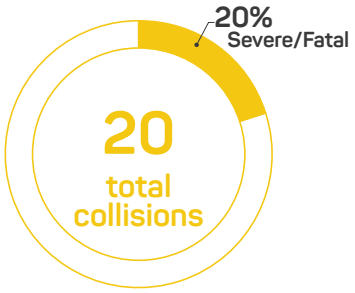
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	4	6
Signalized Intersection	4	6
Unsignalized Intersection	0	0
Total	**8**	**12**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

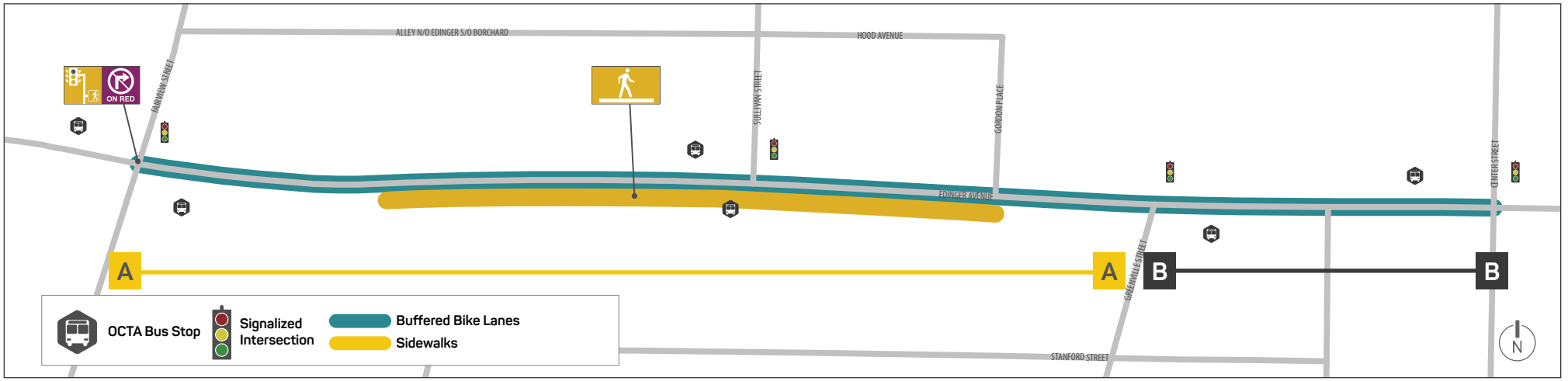
» Mix of mid-block and signalized intersections

Bicycle Collisions

» Mix of mid-block and signalized intersections

06 | EDINGER AVENUE

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of bicycle collisions along this corridor as well as pedestrian and bicycle collisions at Fairview.

- Buffered Bike Lanes
- Eliminate Right Turn on Red
- Monitor Speeds
- Sidewalks
- Leading Pedestrian Interval

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$597,900

Sidewalk	$	260,000
Leading Pedestrian Intervals	$	1,300
Speed Limit Reduction	$	500
Buffered Bike Lanes	$	136,800
Engineering	$	59,790
Fees/Permits/Supervision	$	59,790
Contingencies	$	79,720

EXPECTED BENEFIT/COST RATIO

103.91

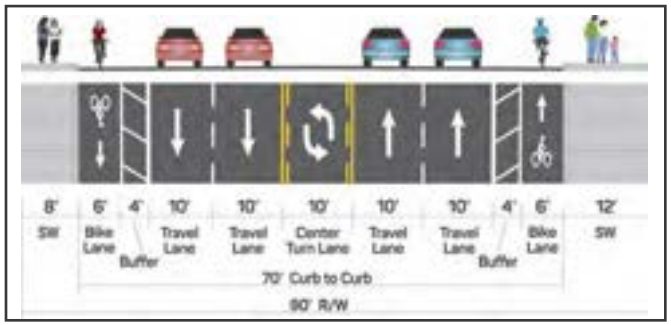
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

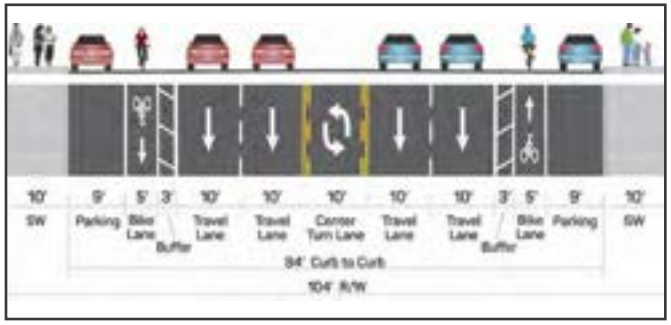
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

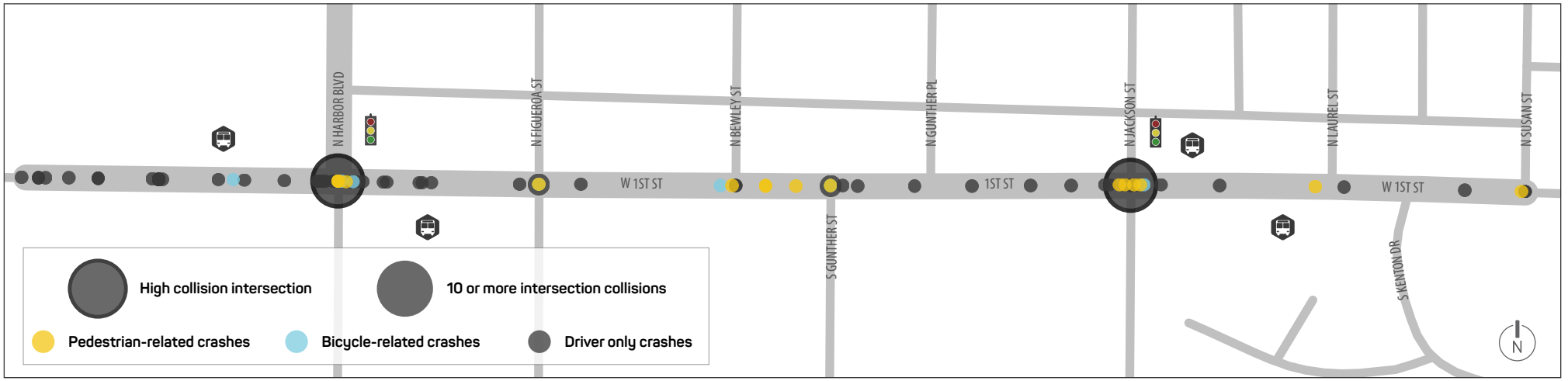


B



07 | FIRST STREET FROM W OF HARBOR BOULEVARD TO SUSAN STREET

COLLISION HISTORY

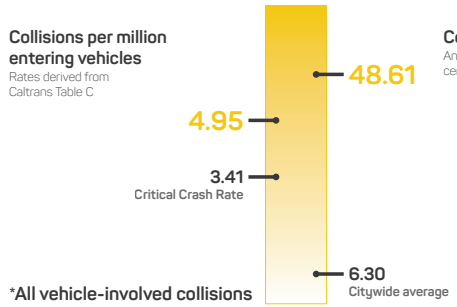


LOCATION DESCRIPTION

West of the Santa Ana River, the distribution of pedestrian and bicycle collisions on 1st reflects activity associated with a mix of residential and commercial development, the #64 bus line, and relatively long distances between signalized intersections. Harbor (pedestrian and bicycle) and Jackson (pedestrian) are high collision intersections.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.47
Number of Lanes	7
ADT	26,900
Schools	-
Transit Lines	64
Major Generators	-

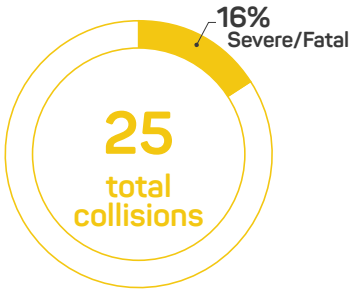
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	1	1
Signalized Intersection	9	4
Unsignalized Intersection	7	3
Total	**17**	**8**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

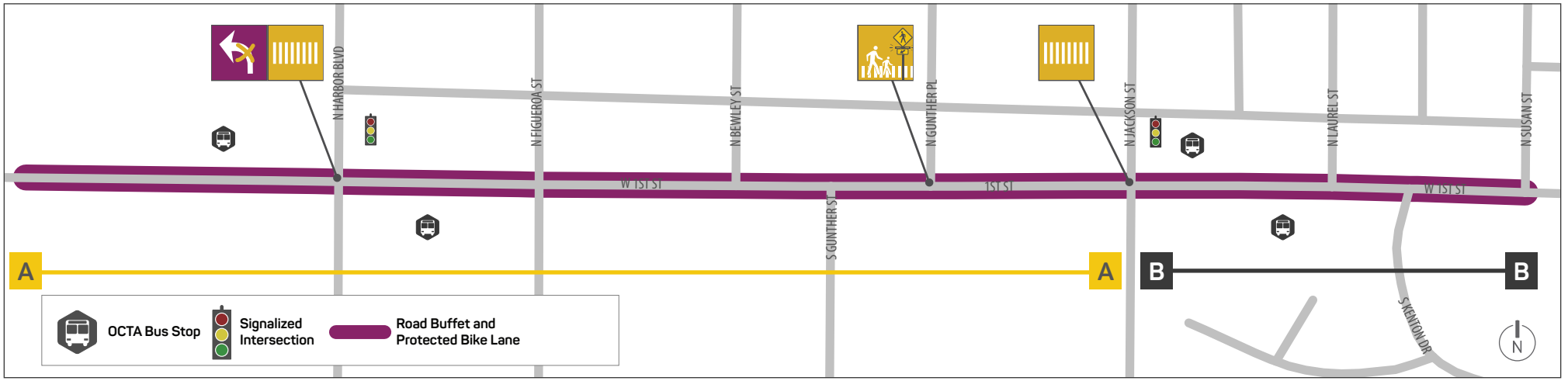
» Mix of signalized and unsignalized intersections

» Half involve through vehicles

Bicycle Collisions

» Mix of signalized and unsignalized intersections

SOLUTIONS



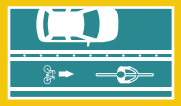
PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequent at both signalized and unsignalized intersections.


Road Buffet


Enhanced Crossing


Remove Turn Lanes


Protected Bike Lanes


Zebra Crosswalk

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$1,583,700

One-Way Protected Bike Lanes	$	365,000
Rectangular Rapid Flashing Beacon	$	14,200
Roadway Lighting	$	30,000
Marked Crosswalk	$	8,600
Traffic Signal Modification	$	250,000
Median (Narrowing and Installation)	$	190,000
Curb and Gutter	$	98,000
Engineering	$	158,370
Fees/Permits/Supervision	$	158,370
Contingencies	$	211,160

EXPECTED BENEFIT/COST RATIO

22.62

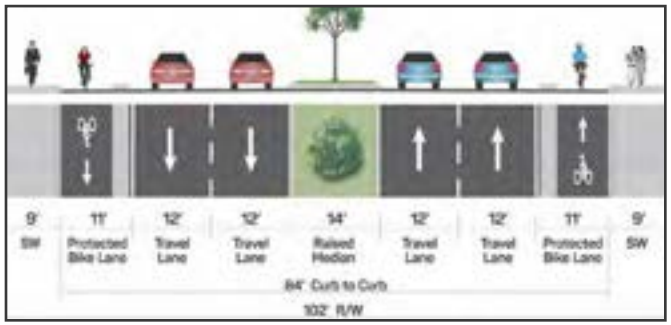
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

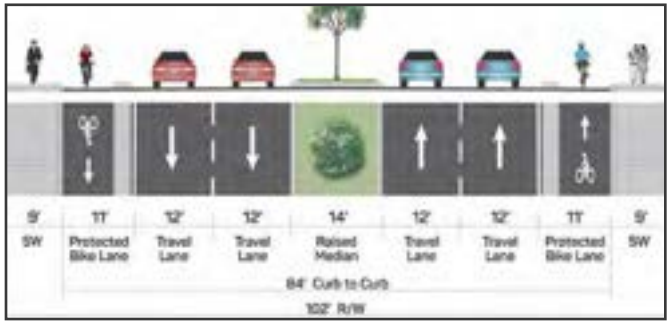
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

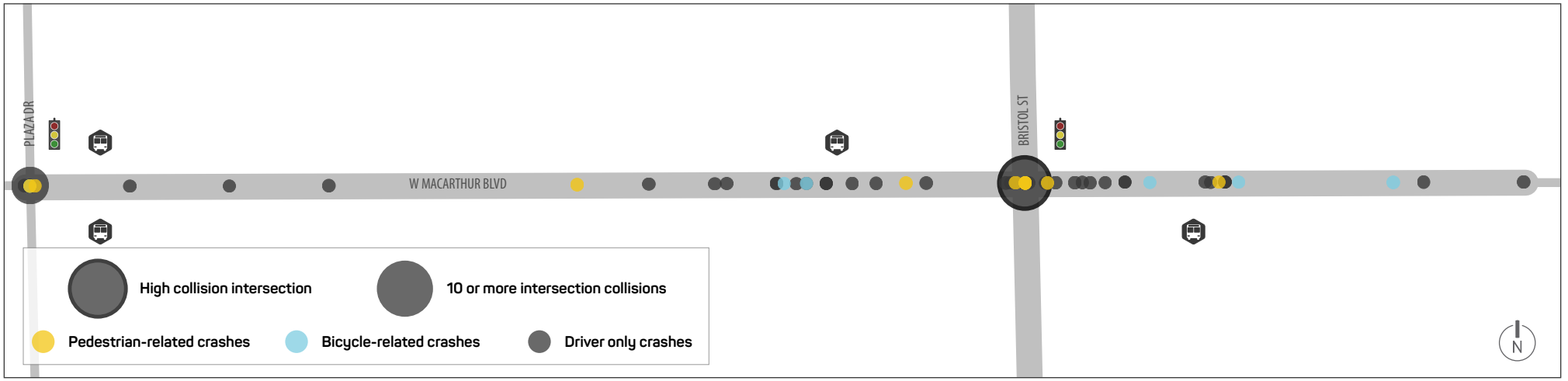


B



08 | MACARTHUR BOULEVARD FROM WESTERN CITY LIMITS TO FLOWER ST

COLLISION HISTORY



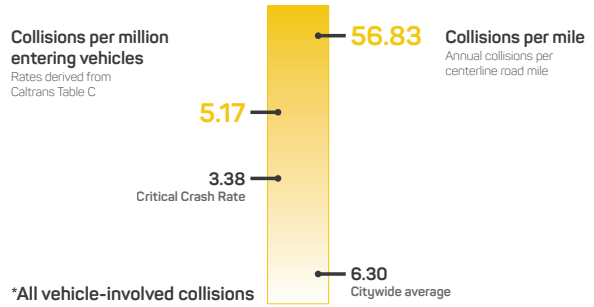
Note - The collision data reflected on this page corresponds to the high collision corridor identified in the analysis for the Safe Mobility Plan: MacArthur Boulevard from S Plaza Dr to E of S Bristol St. The proposed project extent is larger, extending from the western city limits to Flower St.

LOCATION DESCRIPTION

This corridor is characterized by strip commercial development and has a history of pedestrian collisions at signalized intersections as well as mid-block bicycle collisions, frequently associated with driveways. Bristol is high collision intersection for pedestrians.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.29
Number of Lanes	6
ADT	30,100
Schools	-
Transit Lines	51, 86, 145, 173
Major Generators	-

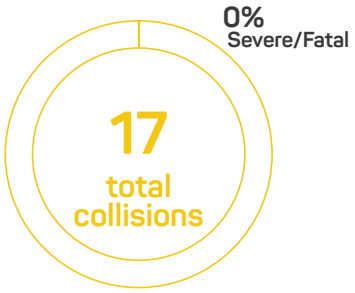
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	3	5
Signalized Intersection	7	2
Unsignalized Intersection	0	0
Total	**10**	**7**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

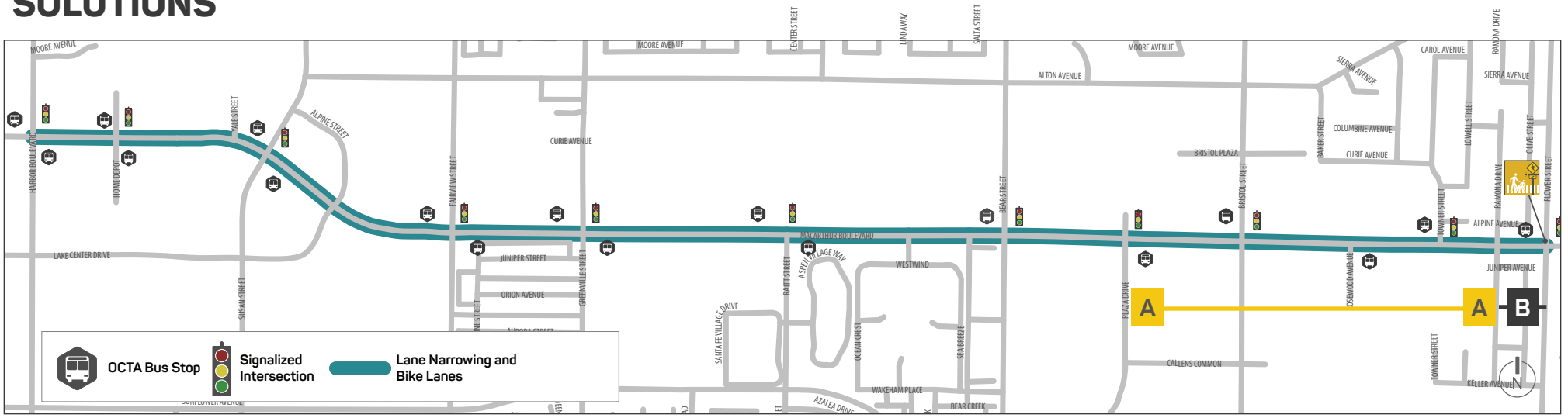
» Approximately two-thirds at signalized intersections

Bicycle Collisions

» Appromiately two-thirds mid-block, including at driveways

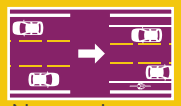
08 | MACARTHUR BOULEVARD

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequently at signalized intersections and mid-block.



Narrow Lanes

Bike Lanes

Enhanced Crossing

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$2,546,400

One-Way Protected Bike Lanes	$	1,314,000
Traffic Signal Modification	$	375,000
Marked Crosswalk	$	8,600
Engineering	$	254,640
Fees/Permits/Supervision	$	254,640
Contingencies	$	339,520

EXPECTED BENEFIT/COST RATIO

14.33

Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

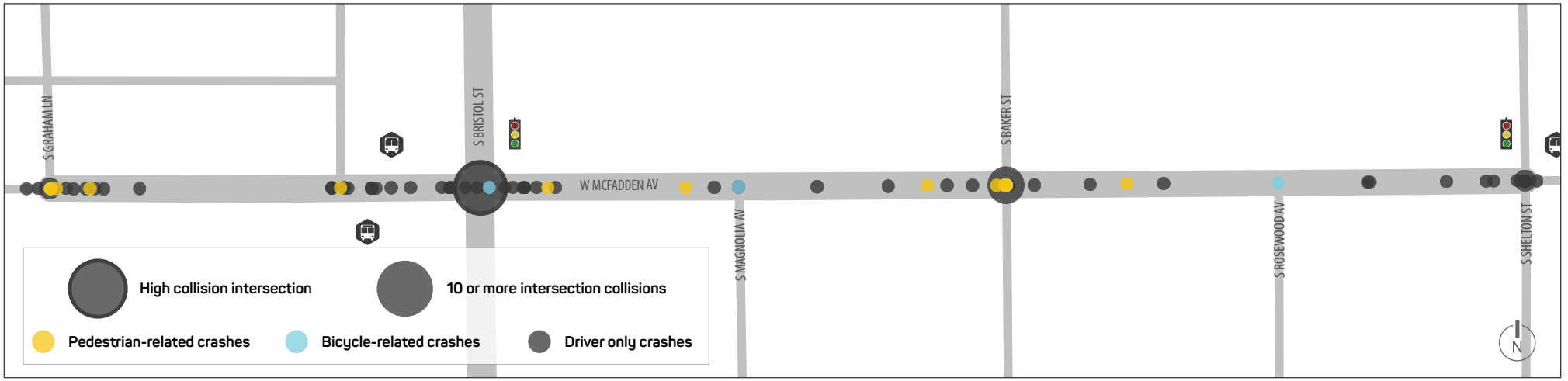
CROSS SECTIONS

A

B

09 | MCFADDEN AVENUE FROM S GRAHAM LN TO S SHELTON ST

COLLISION HISTORY

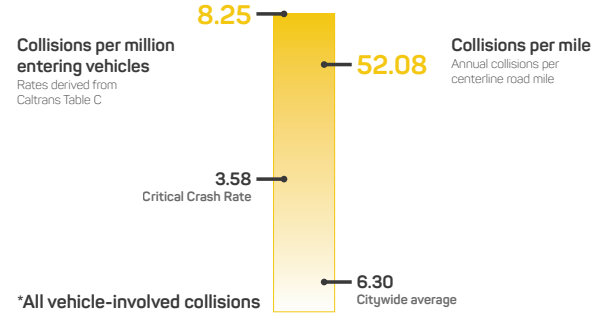


LOCATION DESCRIPTION

The distribution of pedestrian and bicycle collisions on this section of McFadden is reflective of pedestrian crossing demand near Martin Luther King Jr Elementary School, Northgate Market and other commercial businesses, the #66 bus line, and at unsignalized intersections east of Bristol.

Classification	Secondary Arterial
Posted Speed	30 - 35
Length (miles)	0.36
Number of Lanes	2 - 4
ADT	17,300
Schools	Dr Martin Luther King Jr Elementary School
Transit Lines	66
Major Generators	Northgate Market

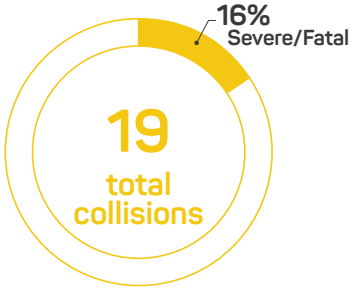
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	4	0
Signalized Intersection	0	1
Unsignalized Intersection	9	5
Total	**13**	**6**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

- » Two-thirds at unsignalized intersections
- » Third at mid-block locations
- » Collisions with through vehicles

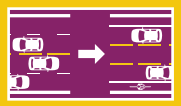
Bicycle Collisions

- » Unsignalized intersections

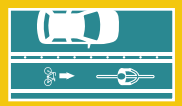
SOLUTIONS

PROJECT DESCRIPTION

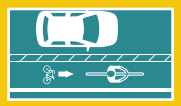
The recommendations respond to the prevalence of pedestrian collisions at unsignalized and mid-block locations as well as a lesser amount of bicycle involved collisions.



Road Buffet



Protected Bike Lanes



Buffered Bike Lanes

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$218,625

One-Way Protected Bike Lanes	$	73,000
Median Refuge Island	$	30,000
Buffered Bike Lane	$	42,750
Engineering	$	21,863
Fees/Permits/Supervision	$	21,863
Contingencies	$	29,150

EXPECTED BENEFIT/COST RATIO

76.08

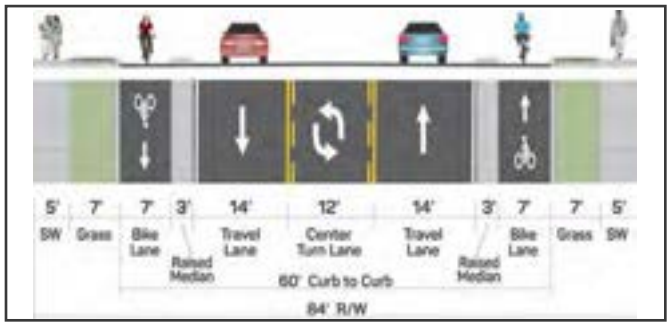
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

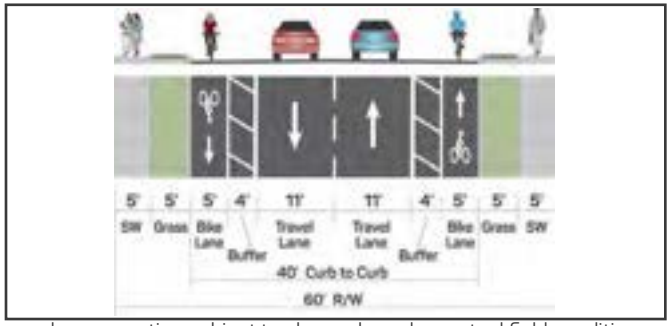
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A



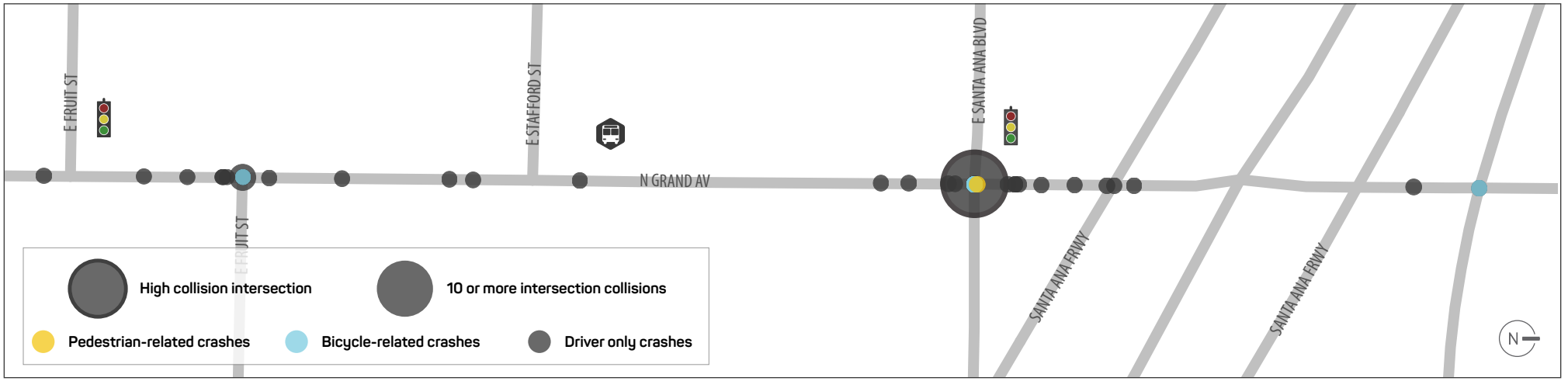
B



Note - Proposed cross section subject to change based on actual field conditions and engineering judgement.

10 | GRAND AVENUE FROM I-5 TO E FRUIT ST

COLLISION HISTORY

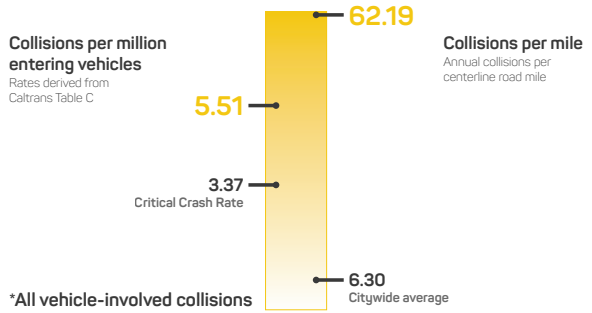


LOCATION DESCRIPTION

The distribution of collisions is reflective of bicycle activity along this segment of Grand which passes below I-5. Bicyclists often travel along the western sidewalk and come into conflict with turning vehicles utilizing the double right turn lanes off Grand. E Santa Ana Blvd is a high collision intersection for bicycles.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.2
Number of Lanes	5
ADT	30,900
Schools	-
Transit Lines	59, 463
Major Generators	-

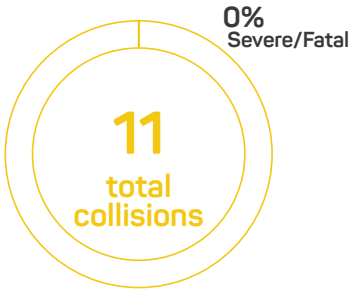
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	0	0
Signalized Intersection	1	8
Unsignalized Intersection	0	2
Total	**1**	**10**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

» N/A

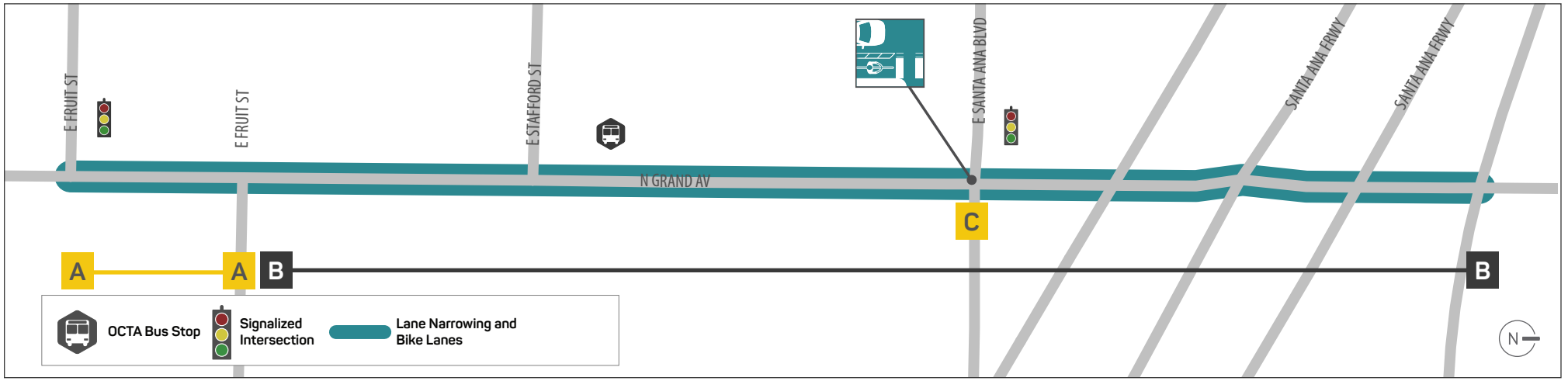
Bicycle Collisions

» Nearly all at signalized intersections

» Collisions with right turning vehicles

» Wrong way riding

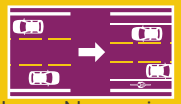
SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of bicycle collisions in the I-5 interchange area.

Bike Lanes



Lane Narrowing

Conflict Markings

CONSISTENCY CONSIDERATIONS

Caltrans right-of-way underneath I-5 freeway.

COST ESTIMATE

$440,850

Bike Lanes	$	40,000
Signal Timing Modification	$	3,900
Traffic Signal Modification	$	250,000
Engineering	$	44,085
Fees/Permits/Supervision	$	44,085
Contingencies	$	58,780

EXPECTED BENEFIT/COST RATIO

2.22

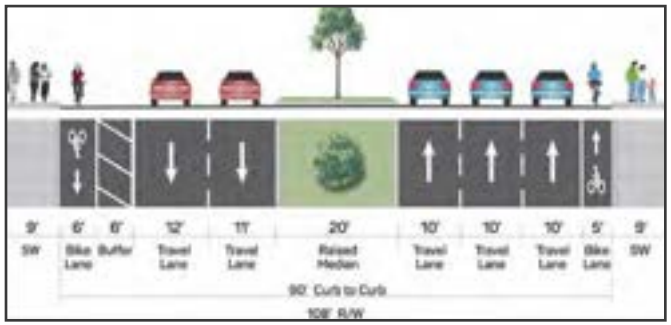
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

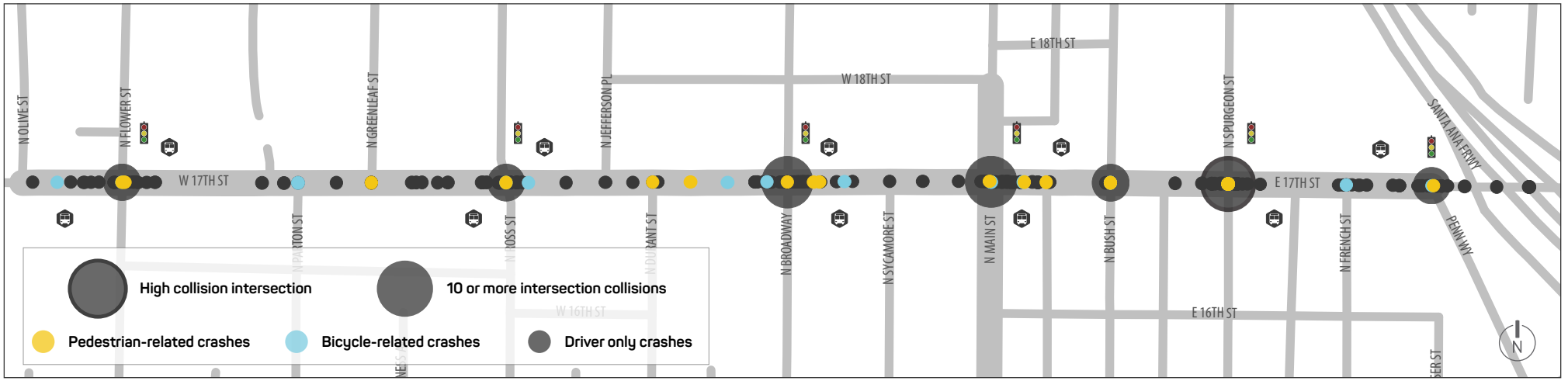
B



C

11 | 17TH STREET FROM OLIVE STREET TO I-5

COLLISION HISTORY

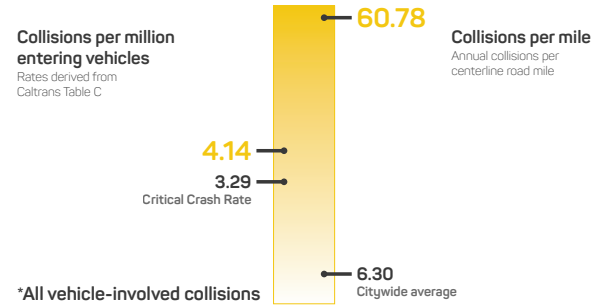


LOCATION DESCRIPTION

West of 1-5, the distribution of collisions on 17th reflects both bicycle and pedestrian activity associated with continuous commercial development, multiple schools, and the #60 bus line. Spurgeon is a high collision intersection for pedestrians.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.88
Number of Lanes	6
ADT	40,200
Schools	Willard Intermediate School; Davis Elementary School
Transit Lines	60
Major Generators	-

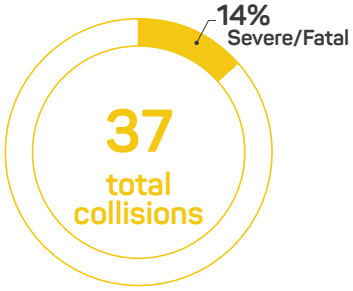
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	5	7
Signalized Intersection	11	5
Unsignalized Intersection	4	5
Total	**20**	**17**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

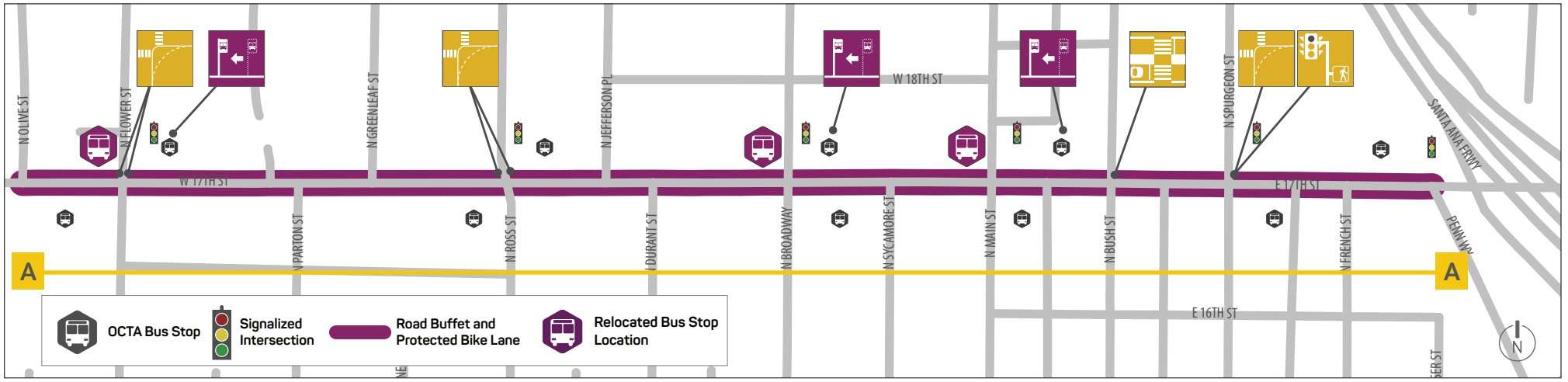
Pedestrian Collisions

- » Half at signalized intersections
- » Collisions with through vehicles

Bicycle Collisions

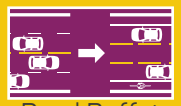
- » Wrong-way riding
- » Collisions at driveways

SOLUTIONS



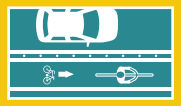
PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor.


Road Buffet


Curb Radius Reduction


Relocate Transit Stops


Protected Bike Lanes


Leading Pedestrian Intervals


Median Refuge Island

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$2,345,100

Curb Radius Reduction	$	105,000
One-Way Protected Bike Lanes	$	657,800
Median Refuge Island and Crosswalk	$	14,100
Traffic Signal Modifications	$	751,300
Speed Limit Reduction	$	1,500
Transit Stop	$	34,500
Engineering	$	234,510
Fees/Permits/Supervision	$	234,510
Contingencies	$	312,680

EXPECTED BENEFIT/COST RATIO

10.69

Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

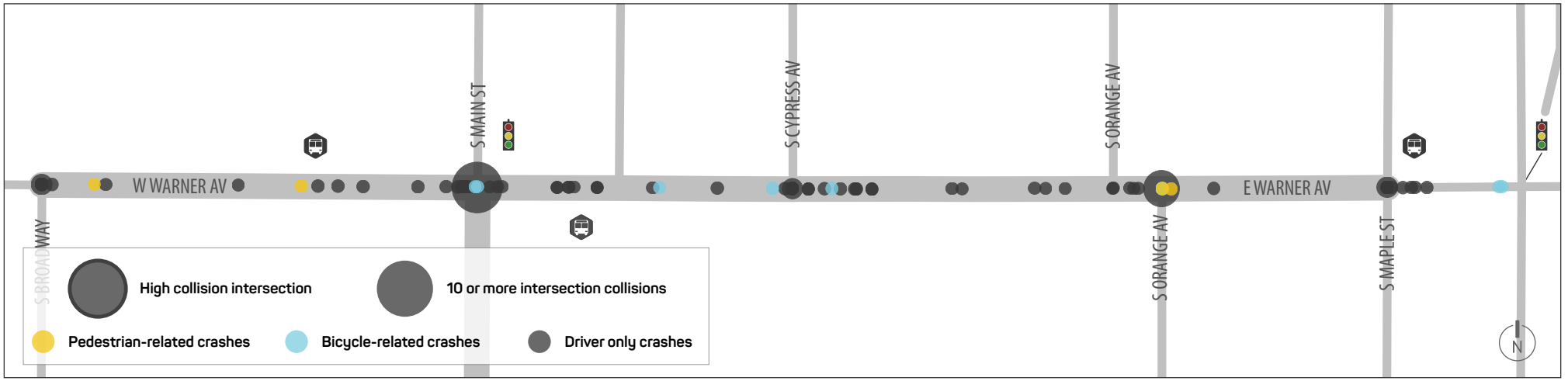
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

13 | WARNER AVENUE FROM BROADWAY TO E OF S MAPLE ST

COLLISION HISTORY

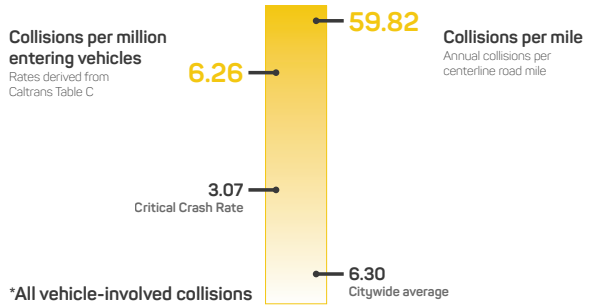


LOCATION DESCRIPTION

Warner has a mix of auto-oriented employment and commercial uses west of Main and is predominantly residential to the east. This corridor is bookended by two large elementary schools and Delhi Park, and is served by the #72 bus line.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.35
Number of Lanes	5
ADT	26,200
Schools	Esqueda Elementary School; James Monroe Elementary School
Transit Lines	72
Major Generators	Delhi Park

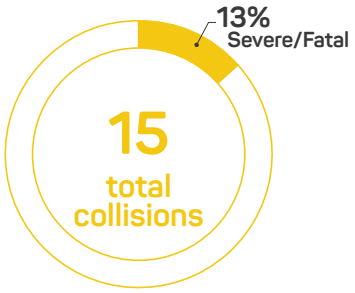
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	2	4
Signalized Intersection	0	2
Unsignalized Intersection	2	5
Total	**4**	**11**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

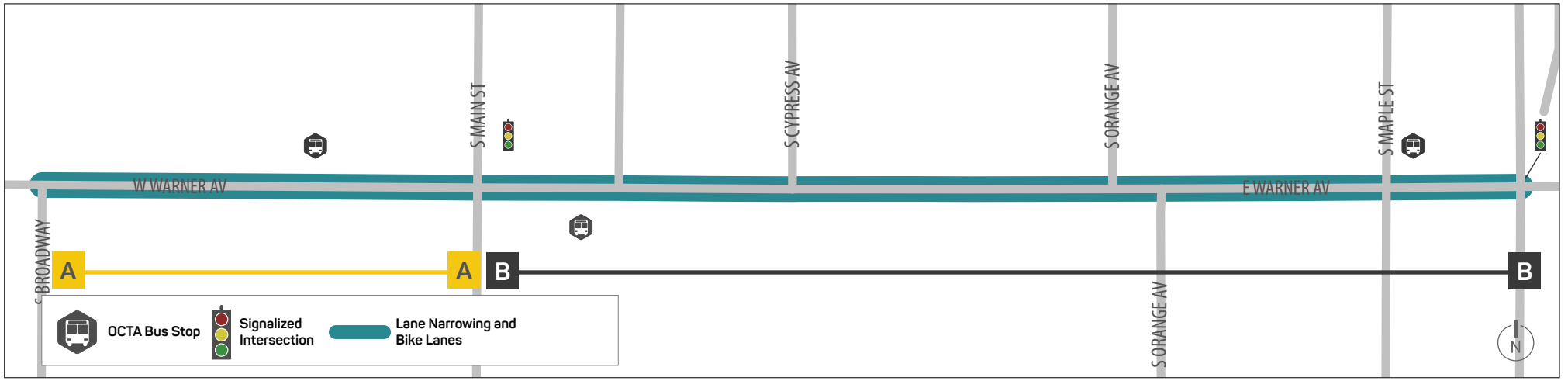
» N/A

Bicycle Collisions

» A mix of unsignalized intersections and mid-block

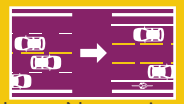
» Collisions at driveways

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of bicycle collisions along this corridor.



Lane Narrowing

Bike Lanes

Monitor Speeds

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$182,550

Bike Lanes	$	64,000
Bike Boulevard	$	57,200
Speed Limit Reduction	$	500
Engineering	$	18,255
Fees/Permits/Supervision	$	18,255
Contingencies	$	24,340

EXPECTED BENEFIT/COST RATIO

32.88

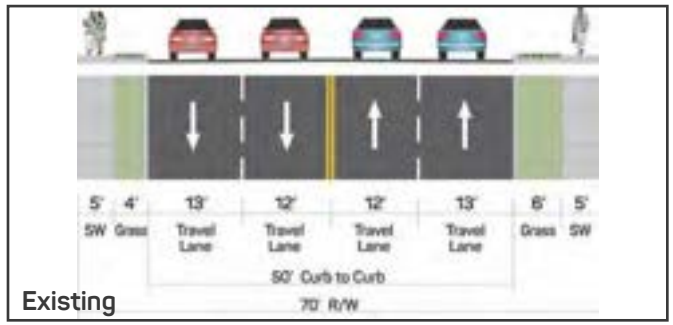
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

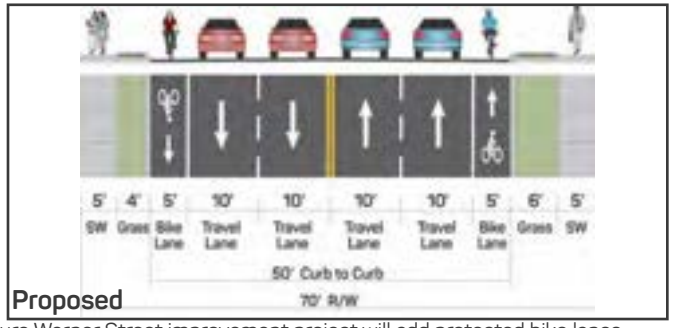
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

B



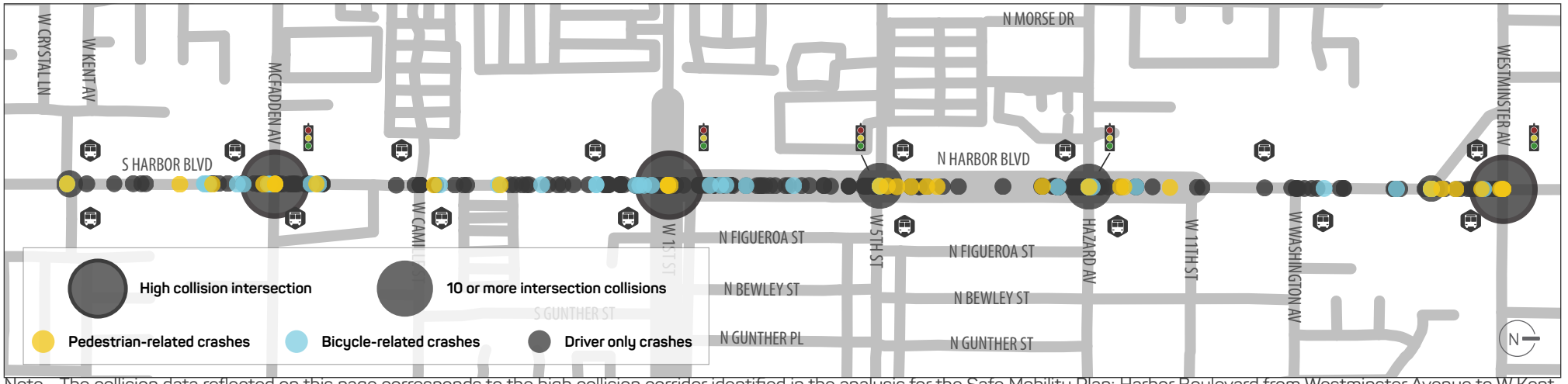
B



Note - Future Warner Street improvement project will add protected bike lanes.

14 | HARBOR BOULEVARD FROM WESTMINSTER AVE TO CITY LIMITS

COLLISION HISTORY



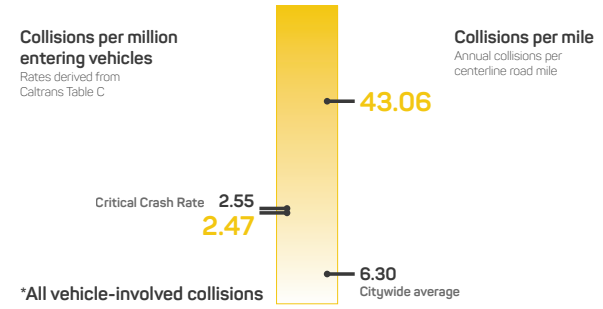
Note - The collision data reflected on this page corresponds to the high collision corridor identified in the analysis for the Safe Mobility Plan: Harbor Boulevard from Westminster Avenue to W Kent Avenue. The proposed project extent is larger than this corridor, extending from Westminster Avenue to the City Limits.

LOCATION DESCRIPTION

Harbor Boulevard is characterized by a wide variety of commercial land uses, frequently with large parking lots. This corridor is near several elementary schools and is served by the #43 and #543 bus lines. 1st (bicycle and pedestrian), McFadden (bicycle and pedestrian), and Westminster (pedestrian) are high collision intersections.

Classification	Major Arterial
Posted Speed	45
Length (miles)	1.87
Number of Lanes	6
ADT	44,200
Schools	Russell Elementary School; Hazard Elementary School
Transit Lines	43, 543
Major Generators	Various commercial land uses

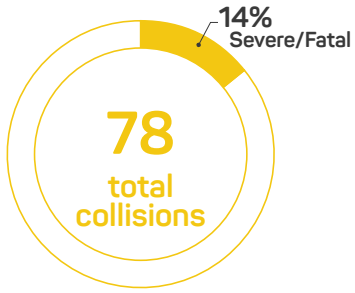
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	17	26
Signalized Intersection	14	15
Unsignalized Intersection	1	5
Total	**32**	**46**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

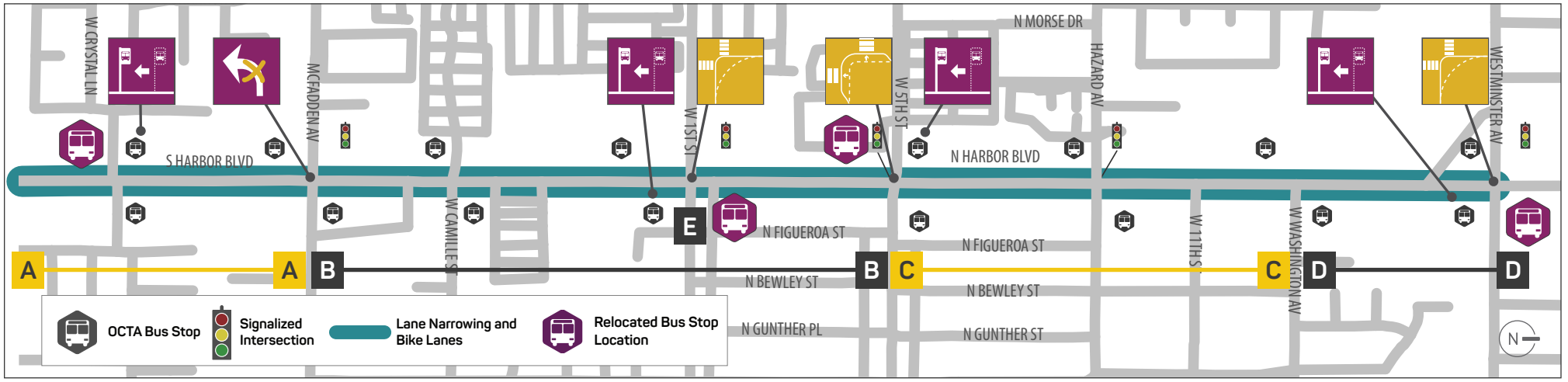
Pedestrian Collisions

- Signalized intersections and mid-block
- Through and right turning vehicles

Bicycle Collisions

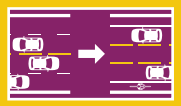
- More than 1/2 mid-block
- 1/3 at signalized intersections
- Wrong way riding
- Collisions at driveways

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequently at signalized intersections and mid-block.


Lane Narrowing


Relocate Transit Stops


Curb Extension


Bike Lanes


Remove Turn Lanes


Curb Radius Reduction

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$742,650

Curb Radius Reduction	$	45,000
Curb Extension	$	40,600
Traffic Signal Modification	$	250,000
Transit Stop	$	34,500
Traffic Signal Modification	$	125,000
Engineering	$	74,265
Fees/Permits/Supervision	$	74,265
Contingencies	$	99,020

EXPECTED BENEFIT/COST RATIO

47.32

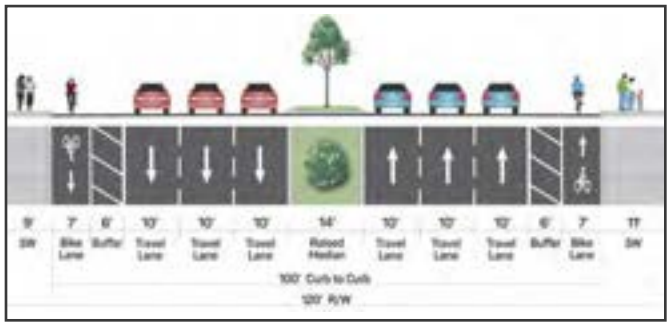
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

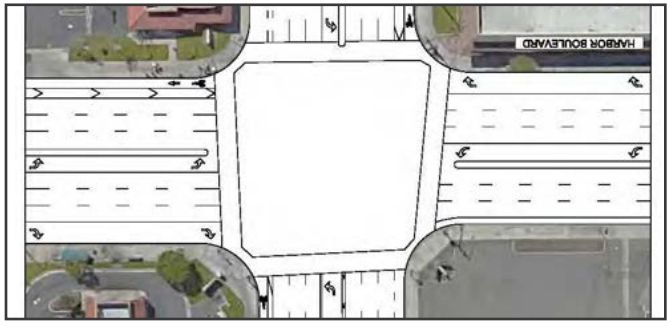
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

C

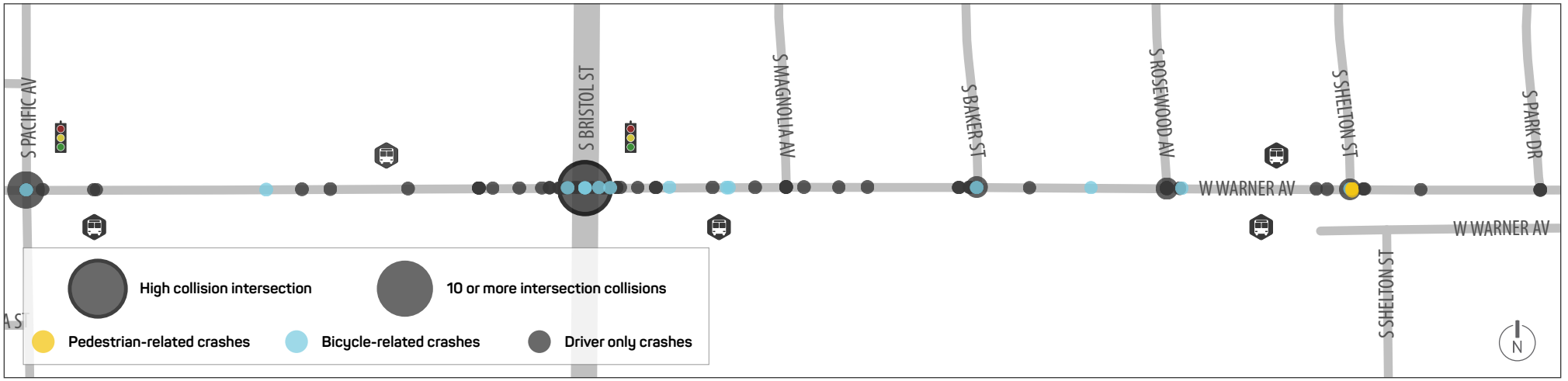


E



15 | WARNER AVENUE FROM S PACIFIC AVE TO S PARK DR

COLLISION HISTORY

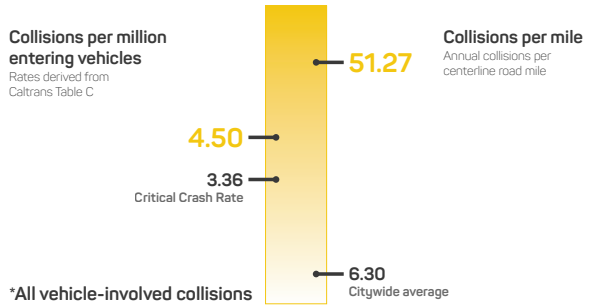


LOCATION DESCRIPTION

The distribution of collisions on Warner in the vicinity of Bristol reflects activity generated by large lot commercial land uses on both sides of this corridor, which is served by the #72 bus line. Bristol is a high collision intersection for bicycles.

Classification	Major Arterial
Posted Speed	40 - 45
Length (miles)	0.41
Number of Lanes	5
ADT	31,200
Schools	-
Transit Lines	72
Major Generators	Continuous commercial development

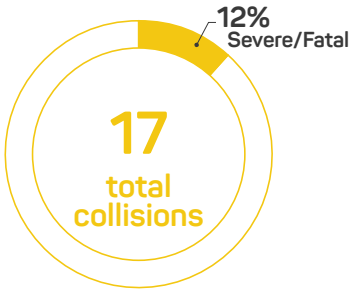
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	0	5
Signalized Intersection	0	6
Unsignalized Intersection	3	3
Total	**3**	**14**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

» N/A

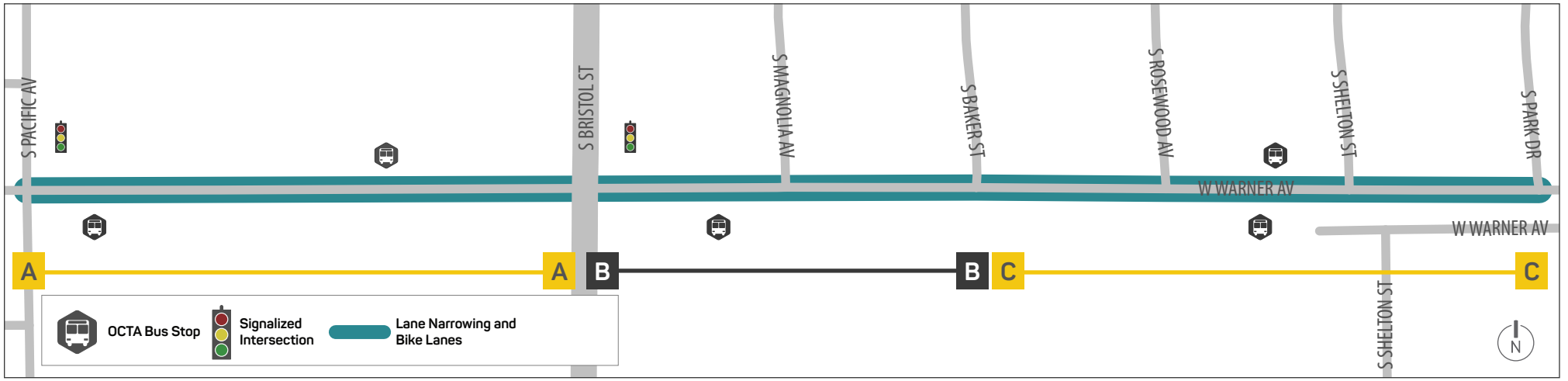
Bicycle Collisions

» Mix of signalized intersections and mid-block

» Collisions with right turning vehicles

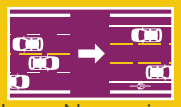
» Wrong way riding

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of bicycle collisions along this corridor.



Lane Narrowing

Bike Lanes

Monitor Speeds

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$189,150

Speed Limit Reduction	$	500
Buffered Blke Lane	$	68,400
Bike Boulevard	$	57,200
Engineering	$	10,355
Fees/Permits/Supervision	$	10,355
Contingencies	$	13,680

EXPECTED BENEFIT/COST RATIO

53.77

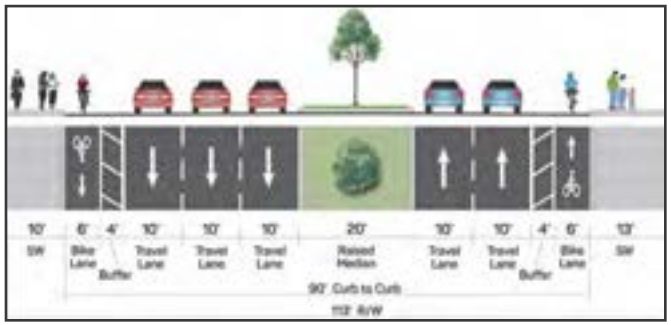
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

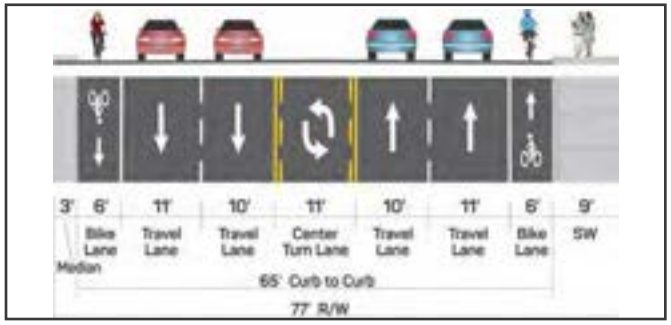
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

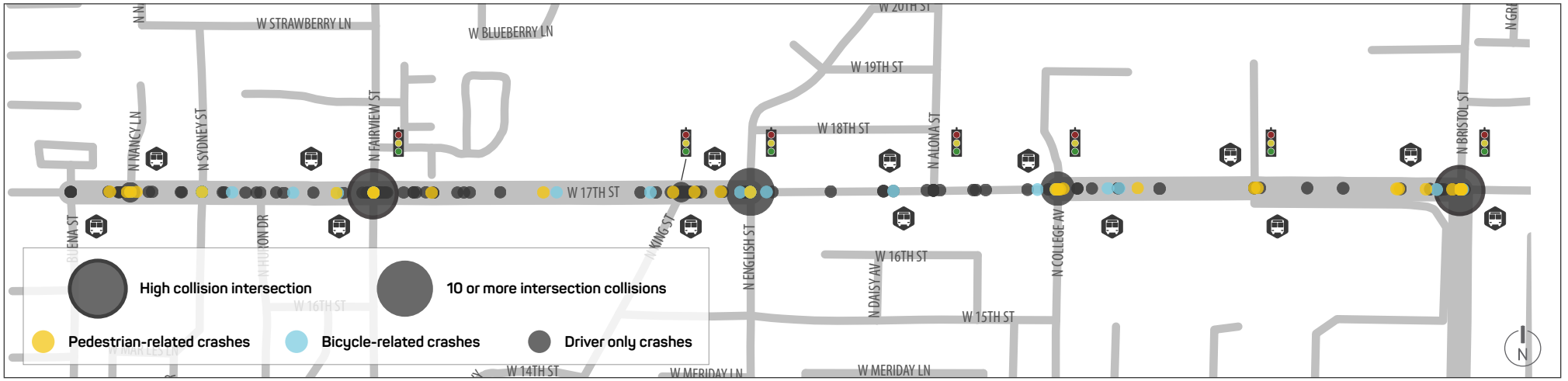


B



16 | 17TH STREET FROM BUENA ST TO BRISTOL ST

COLLISION HISTORY

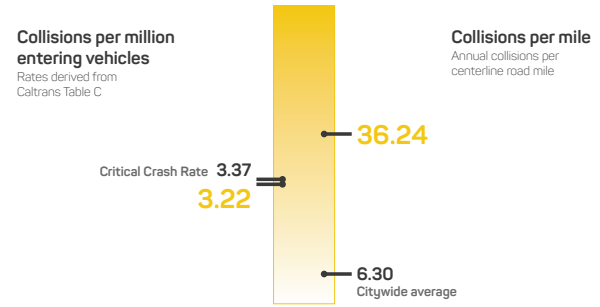


LOCATION DESCRIPTION

From the western city limits to Bristol, the distribution of bicycle and pedestrian collisions reflects the activity of strip commercial development, Santa Ana College, and the #60 bus line. Fairview and Bristol are both high collision intersections for pedestriand and bicycles.

Classification	Major Arterial
Posted Speed	40
Length (miles)	1.31
Number of Lanes	6 - 7
ADT	30,800
Schools	Mendez Intermediate School; Samueli Academy
Transit Lines	60
Major Generators	Santa Ana College; Kindred Hospital Santa Ana

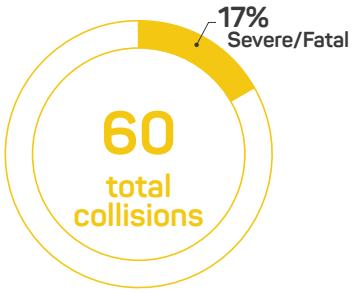
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	10	11
Signalized Intersection	18	14
Unsignalized Intersection	4	3
Total	**32**	**28**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

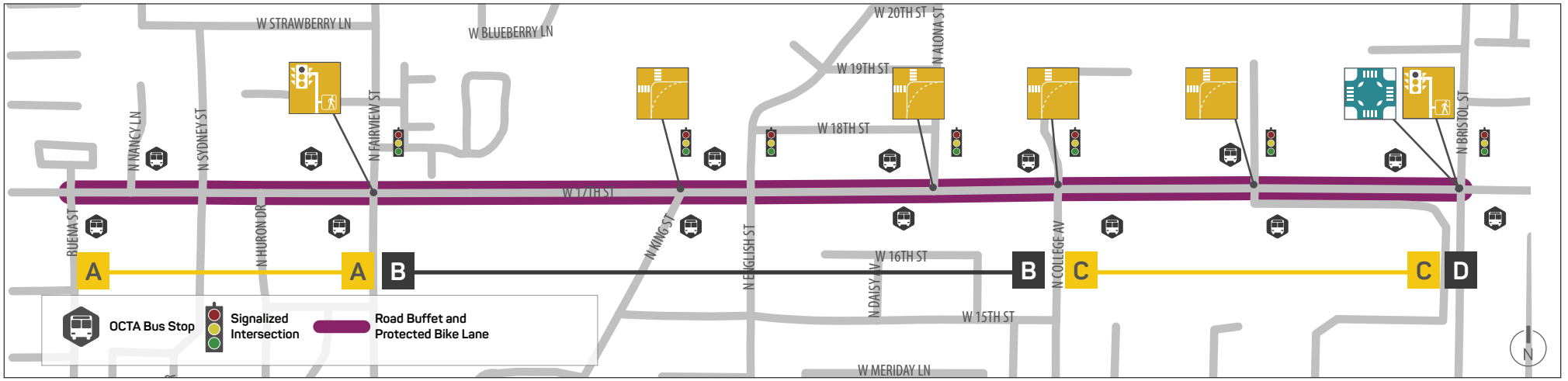
Pedestrian Collisions

- » Over half at signalized intersections
- » Nearly a third mid-block
- » Conflicts with turning vehicles

Bicycle Collisions

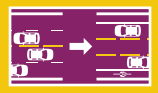
- » Half at signalized intersections
- » Nearly a third mid-block
- » Wrong way riding

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequently at signalized intersections and mid-block.


Road Buffet


Curb Radius Reduction


Protected Intersection


Protected Bike Lane


Leading Pedestrian Intervals

Speed Monitoring

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$2,877,150

Curb Radius Reductions	$	90,000
One-Way Protected Bike Lanes	$	949,000
Leading Pedestrian Intervals	$	2,600
Speed Limit Reduction	$	1,500
Traffic Signal Modification	$	875,000
Engineering	$	287,715
Fees/Permits/Supervision	$	287,715
Contingencies	$	383,620

EXPECTED BENEFIT/COST RATIO

5.83

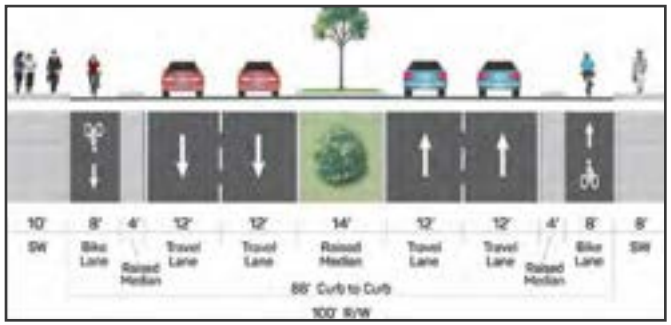
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

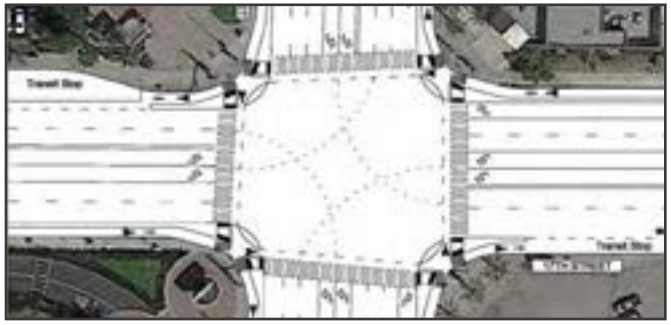
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

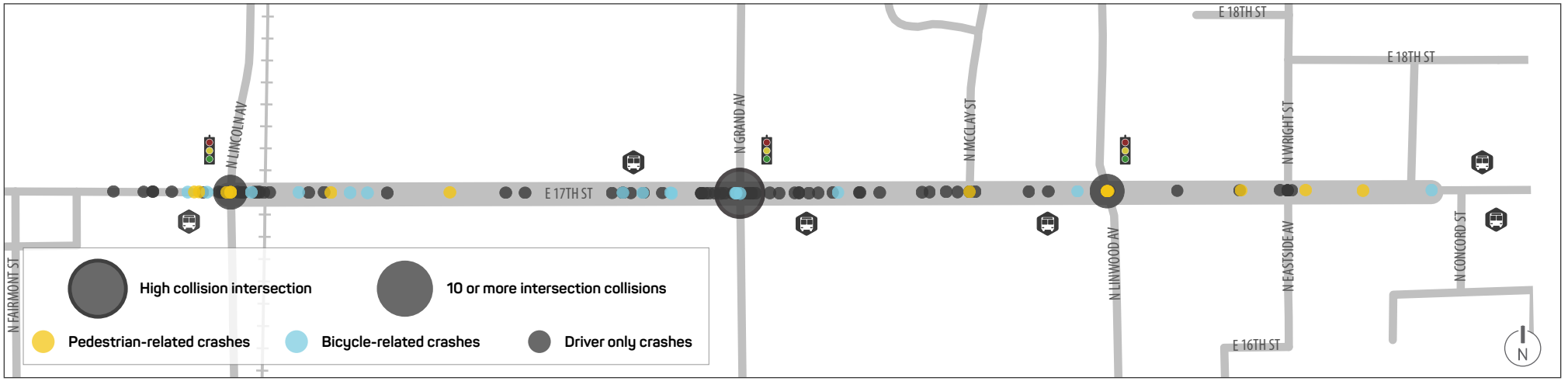


D



17 | 17TH STREET FROM W OF N LINCOLN AV TO CONCORD ST

COLLISION HISTORY

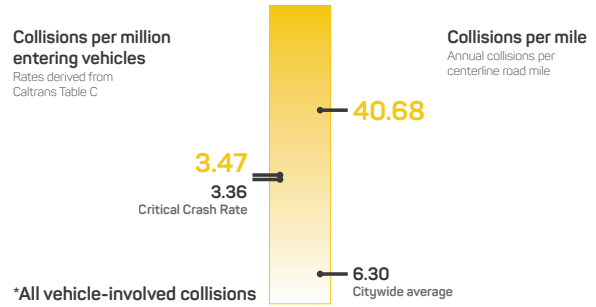


LOCATION DESCRIPTION

The distribution of collisions on 17th east of 1-5 reflects bicycle and pedestrian activity near a variety of commercial uses - many with large parking lots - as well as a school, college, and the #60 bus line. Grand is a high collision intersection for bicycles.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.67
Number of Lanes	6 - 7
ADT	32,100
Schools	Sierra Intermediate School; ATI College
Transit Lines	60
Major Generators	-

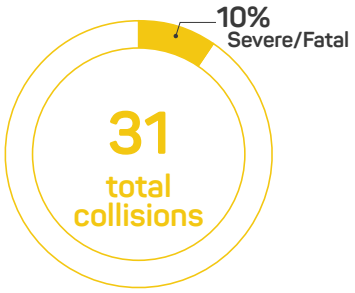
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	6	13
Signalized Intersection	7	3
Unsignalized Intersection	2	0
Total	**15**	**16**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

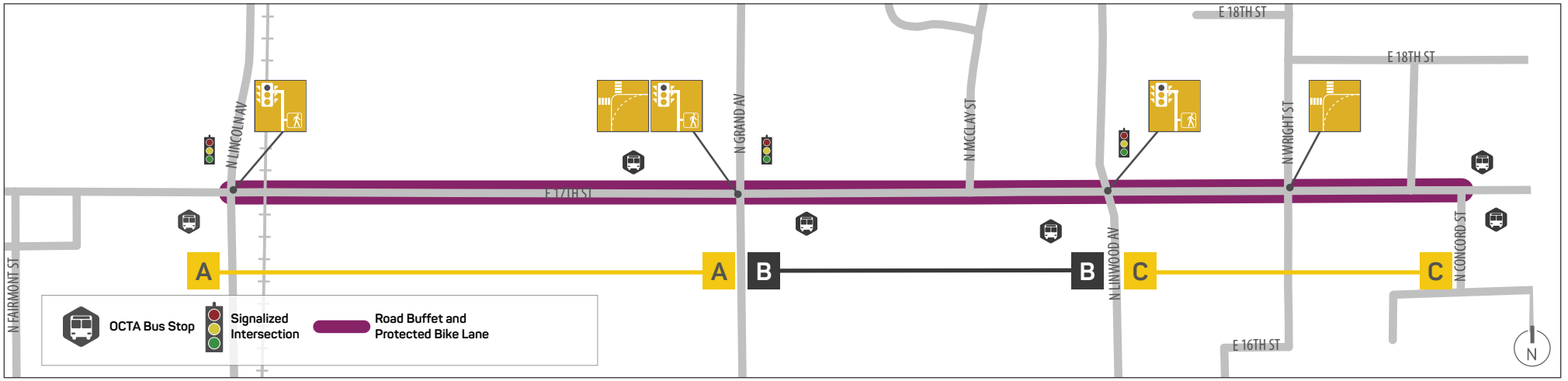
Pedestrian Collisions

- » 1/2 at signalized intersection
- » 1/2 at mid-block
- » Collisions with through vehicles

Bicycle Collisions

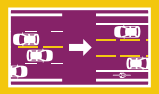
- » 3/4 at mid-block
- » Collisions at driveways

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequently at signalized intersections and mid-block.


Road Buffet


Leading Pedestrian Intervals


Protected Bike Lane


Curb Radius Reduction

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$2,139,600

Curb Radius Reduction	$	45,000
One-Way Protected Bike Lanes	$	912,500
Median Refuge Island	$	90,000
Leading Pedestrian Interval	$	3,900
Traffic Signal Modifications	$	375,000
Engineering	$	213,960
Fees/Permits/Supervision	$	216,960
Contingencies	$	285,280

EXPECTED BENEFIT/COST RATIO

5.28

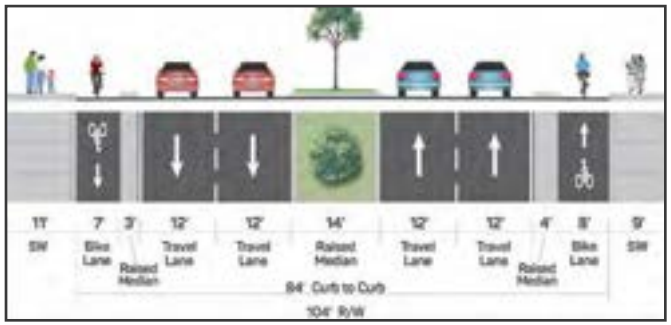
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

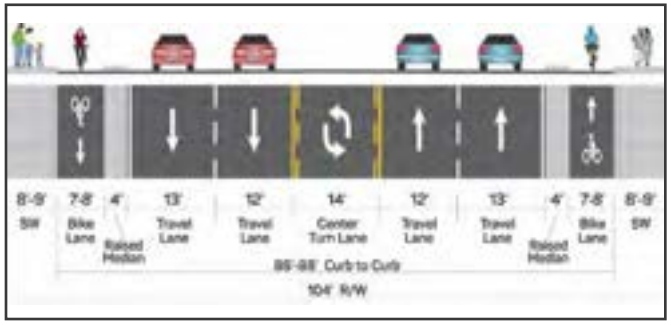
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

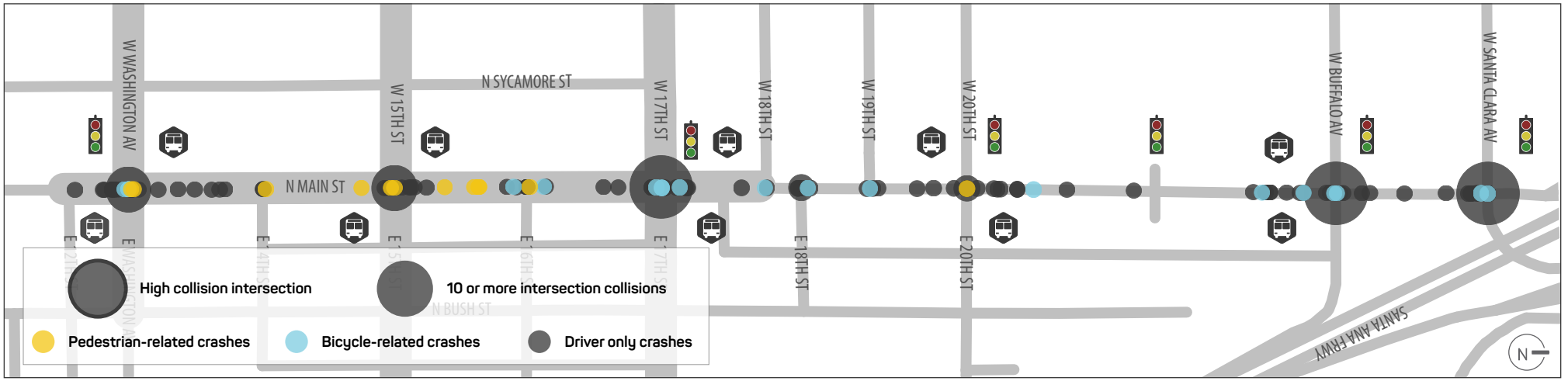


B



18 | MAIN STREET FROM SANTA CLARA AVENUE TO E 12TH ST

COLLISION HISTORY

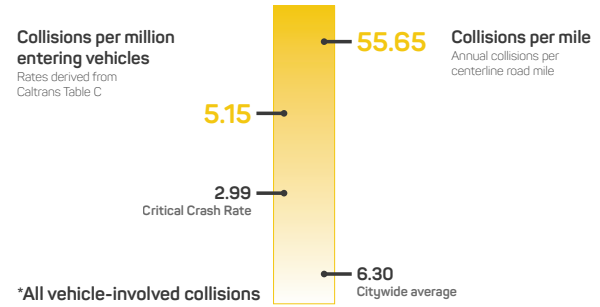


LOCATION DESCRIPTION

The distribution of collisions on Main north of downtown and south of I-5 reflects pedestrian activity along the southern extent and its commercial land uses close to downtown and the #53 bus line. Bicycle collisions are distributed throughout the corridor, which is one of a few streets in the area that crosses I-5.

Classification	Major and Secondary Arterial
Posted Speed	35
Length (miles)	0.81
Number of Lanes	5
ADT	29,600
Schools	Davis Elementary School; Willard Intermediate School
Transit Lines	53
Major Generators	Downtown commercial and crossing I-5

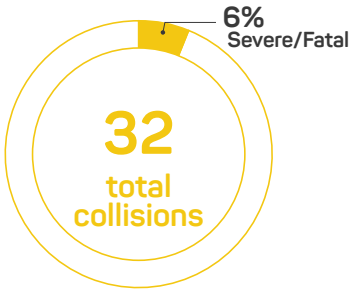
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	5	5
Signalized Intersection	3	11
Unsignalized Intersection	4	4
Total	**12**	**20**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

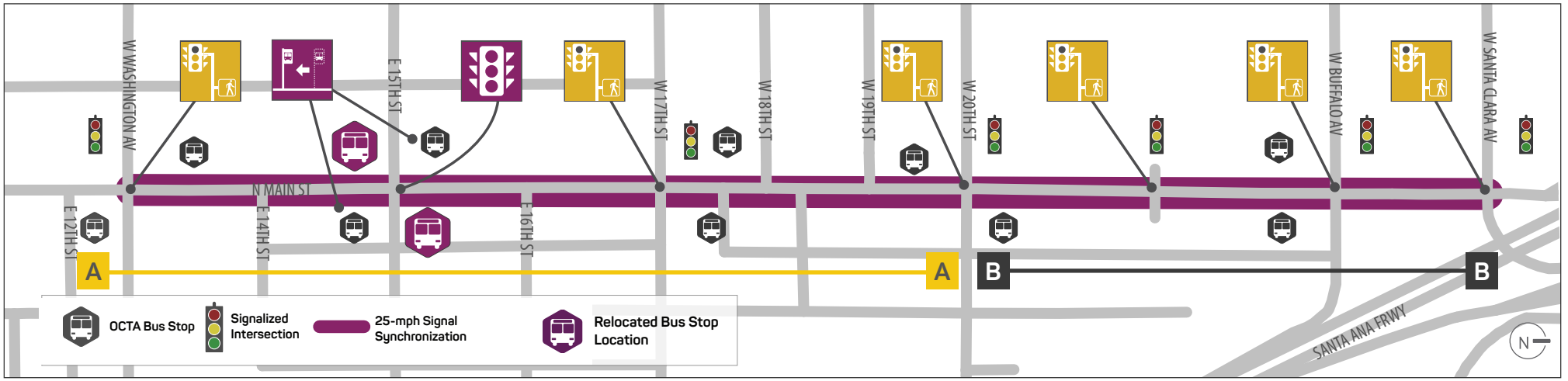
Pedestrian Collisions

- Collisions mostly at south end of corridor
- Mix of signalized and unsignalized intersections and mid-block

Bicycle Collisions

- 1/2 at signalized intersections
- 1/2 at unsignalized intersections and mid-block

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of pedestrian collisions throughout the southern extent closest to downtown and bicycle collisions throughout the corridor.

- Parallel Bicycle Boulevard
- Study for Traffic Signal Warrant
- Signal Synchronization
- Relocate Transit Stop
- Leading Pedestrian Intervals

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$417,000

Neighborhood Greenway	$	114,400
Leading Pedestrian Intervals	$	7,800
Signal Timing Modifications	$	7,800
Transit Stop	$	23,000
Traffic Signal Modifications	$	125,000
Engineering	$	41,700
Fees/Permits/Supervision	$	41,700
Contingencies	$	55,600

EXPECTED BENEFIT/COST RATIO

5.16

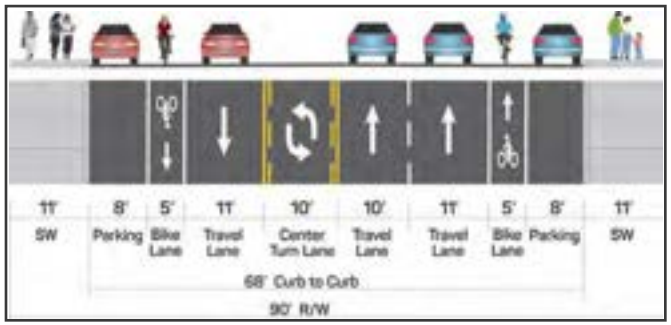
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

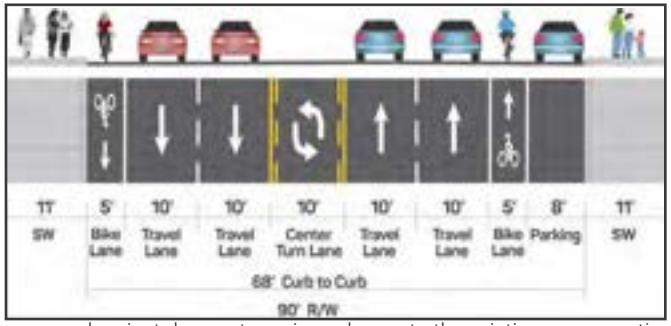
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A



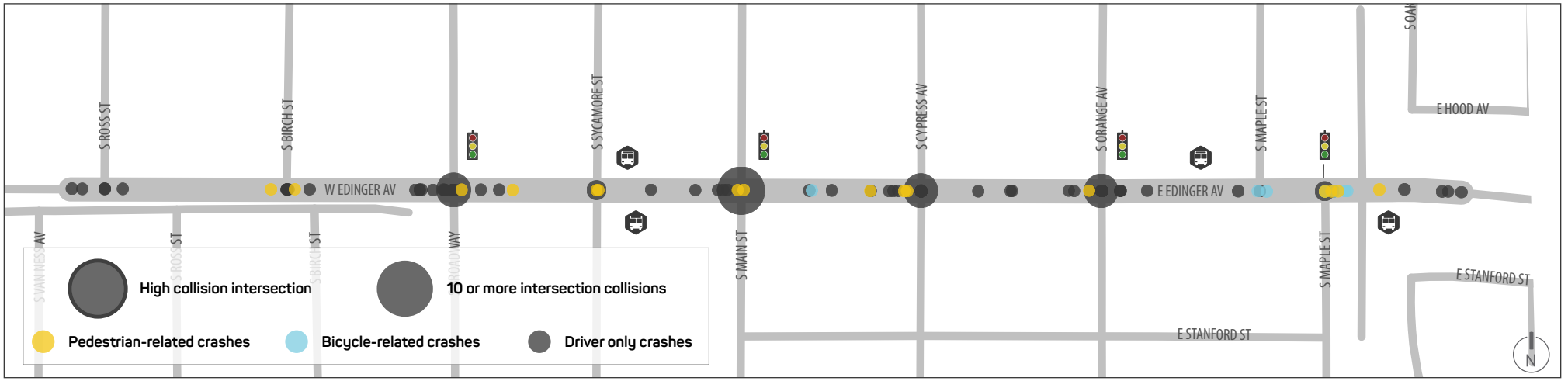
B



Note - The proposed project does not require a change to the existing cross-section. The cross-sections shown illustrate how a road buffet could allow for adding bicycle facilities, if speeds and collisions don't decrease sufficiently.

19 | EDINGER AVENUE FROM S ROSS ST TO E OF S MAPLE ST

COLLISION HISTORY

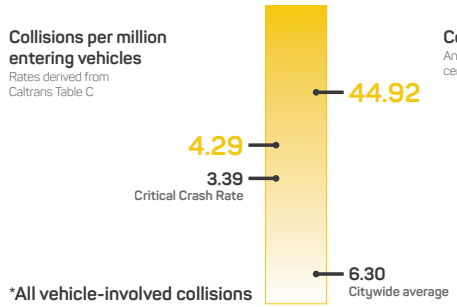


LOCATION DESCRIPTION

The distribution of pedestrian and bicycle collisions is reflective of a stretch of commercial activity along Edinger as well as the #70 bus line.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.58
Number of Lanes	4 - 5
ADT	28,700
Schools	-
Transit Lines	70
Major Generators	-

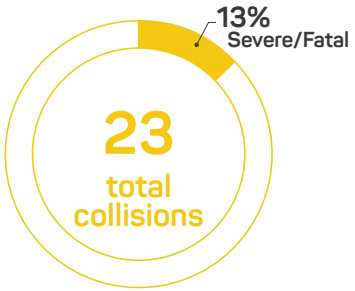
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	3	1
Signalized Intersection	7	4
Unsignalized Intersection	6	2
Total	**16**	**7**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

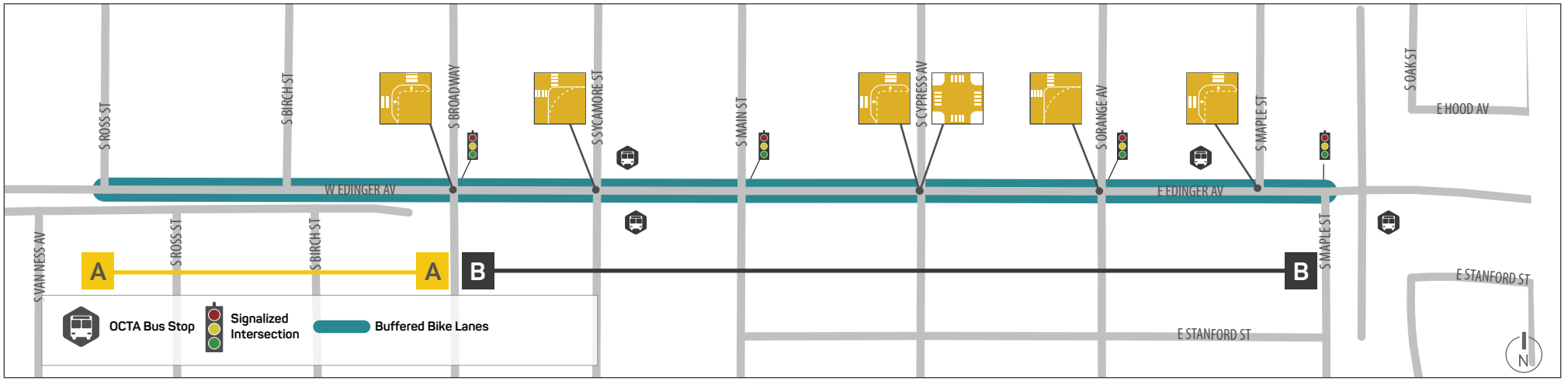
» Mix of signalized and unsignalized intersections

» More than half with through vehicles

Bicycle Collisions

» Signalized intersections

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of collisions involving pedestrians attempting to cross the road at both signalized and unsignalized intersections throughout this corridor, as well as a lesser number of bicycle involved collisions.

- Road Buffet
- Curb Radius Reductions
- Remove Turn Lanes
- Buffered Bike Lanes
- Curb Extensions
- Crosswalks

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$2,693,700

Road Buffet	$	50,400
Curb Extensions/Radius Reductions	$	192,400
Marked Crosswalk	$	12,900
Traffic Signal Modification	$	375,000
Median Narrowing	$	993,750
Curb and Gutter	$	92,750
Buffered Bike Lanes	$	78,600
Engineering	$	269,370
Fees/Permits/Supervision	$	269,370
Contingencies	$	359,160

EXPECTED BENEFIT/COST RATIO

3.09

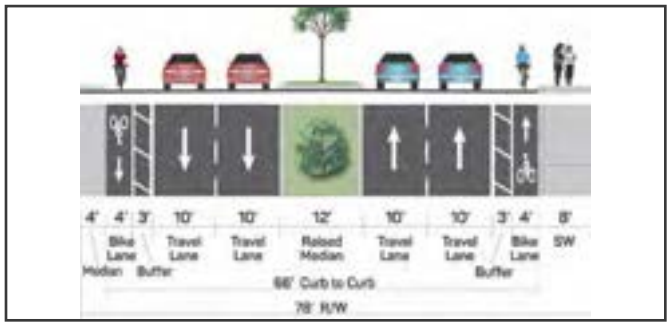
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

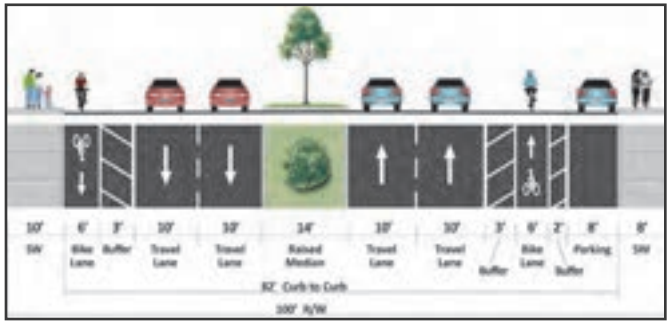
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

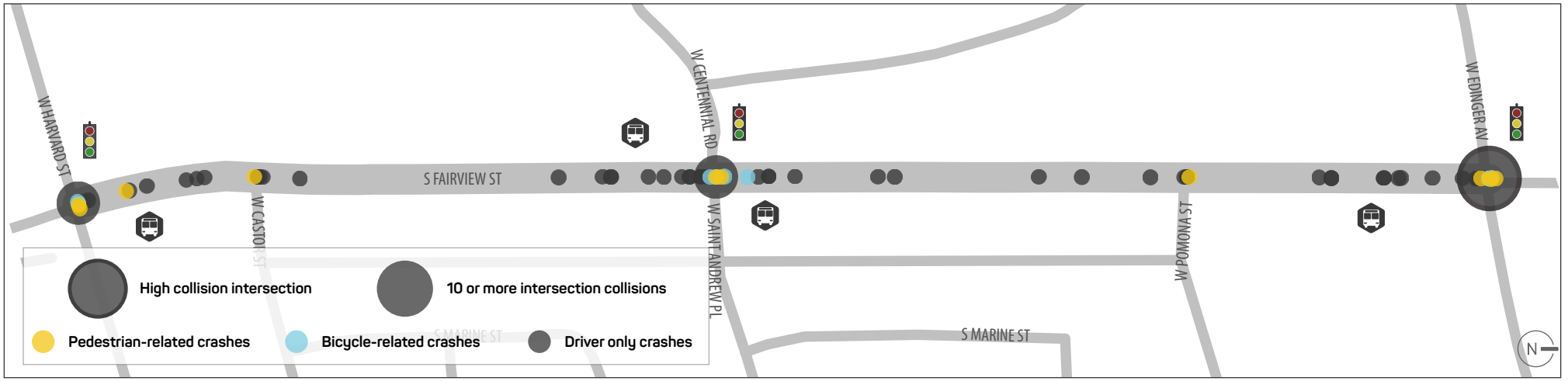


B



21 | FAIRVIEW STREET FROM W EDINGER AV TO W HARVARD ST

COLLISION HISTORY

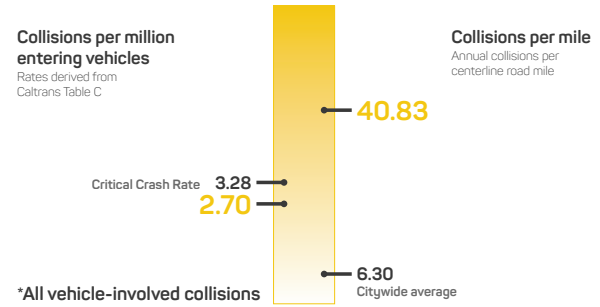


LOCATION DESCRIPTION

The distribution of collisions reflects conflicts between both pedestrians and bicyclists with motorists at signalized intersections, frequently with turning vehicles. Edinger is a high collision intersection for both pedestrians and bicyclists.

Classification	Major Arterial
Posted Speed	45
Length (miles)	0.51
Number of Lanes	7
ADT	41,400
Schools	Godinez Fundamental High School; Kenneth Mitchell School
Transit Lines	47
Major Generators	Centennial Regional Park

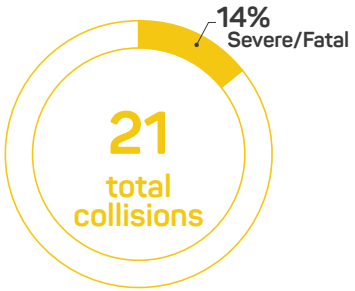
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	2	4
Signalized Intersection	2	12
Unsignalized Intersection	0	1
Total	**4**	**17**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

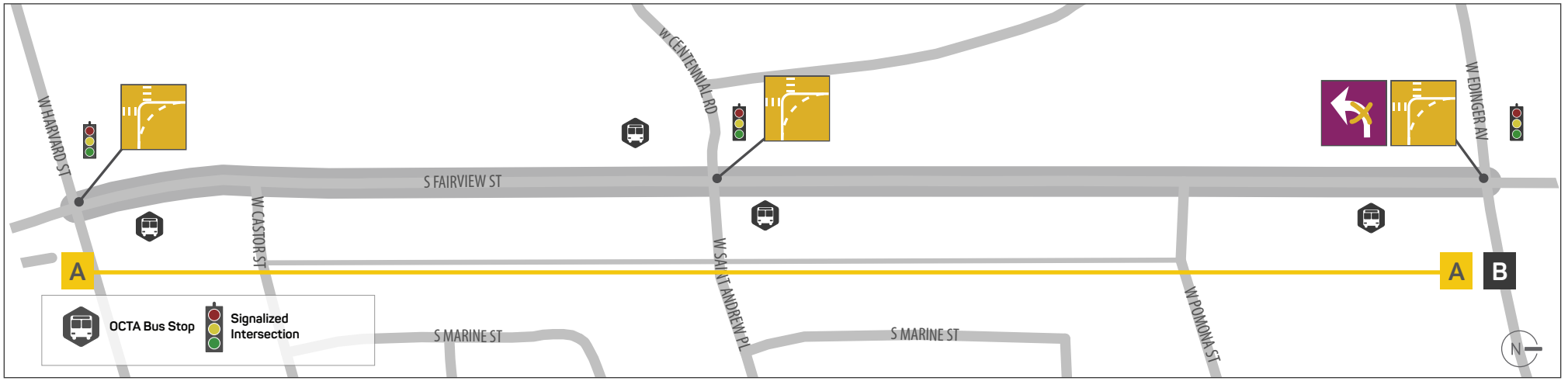
» N/A (4 collisions)

Bicycle Collisions

» Nearly all at signalized intersections

» Collisions with turning vehicles

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycling involved collisions at the signalized intersections on this corridor. These include removing eastbound curb lane from both sides of the Edinger at Fairview intersection, evaluating the potential to extend planned multi-purpose path on Fairview to McFadden, and curb radius reductions as illustrated on the map.

Curb Radius Reduction

Evaluate Path Extension

Remove Lanes

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$255,000

Curb Radius Reduction	$	45,000
Traffic Signal Modification	$	125,000
Engineering	$	25,500
Fees/Permits/Supervision	$	25,500
Contingencies	$	34,000

EXPECTED BENEFIT/COST RATIO

14.66

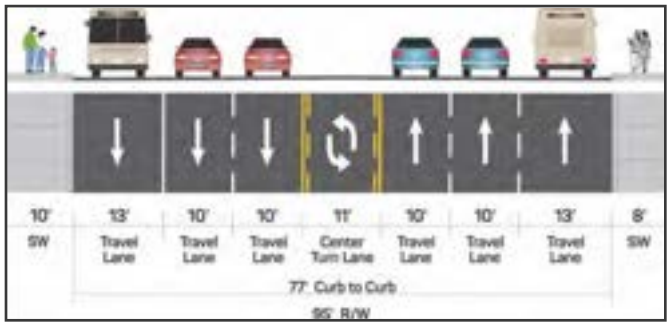
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

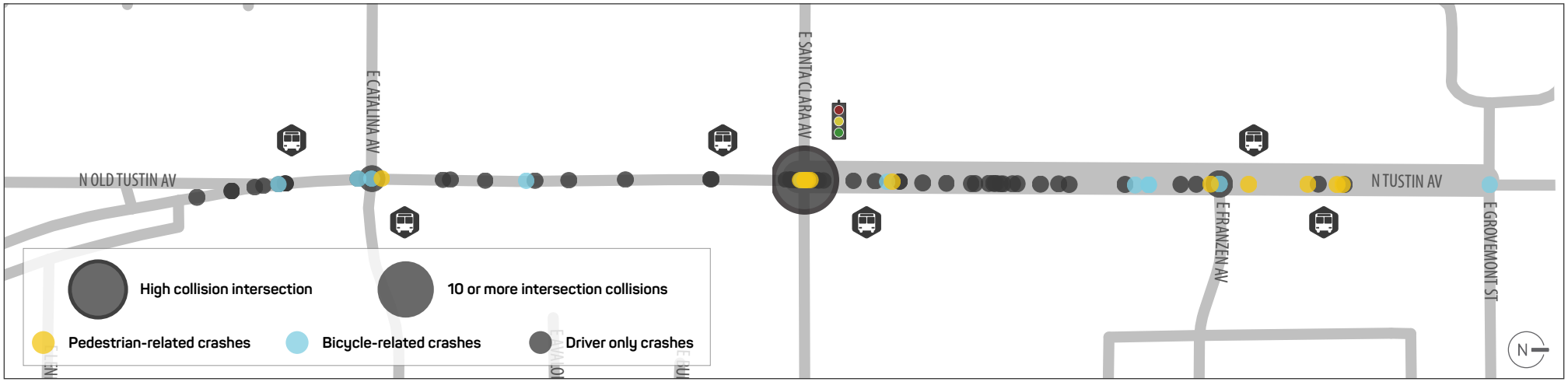
A



B

23 | TUSTIN AVENUE FROM E GROVEMONT ST TO E LENITA LN

COLLISION HISTORY

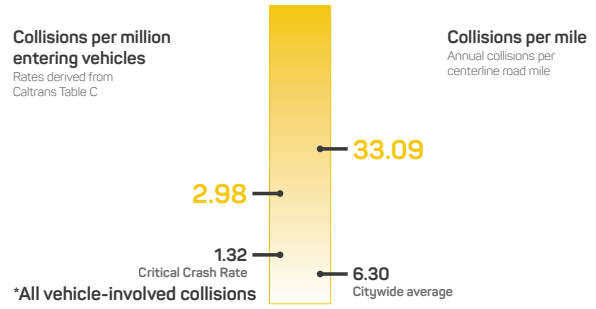


LOCATION DESCRIPTION

The distribution of bicycle and pedestrian collisions on Tustin by the northern city limits reflects activity from a mix of commercial and residential developments, including several apartments, and the #71 bus line. Santa Clara is a high collision intersection for pedestrians.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.58
Number of Lanes	5 - 7
ADT	30,400
Schools	-
Transit Lines	71
Major Generators	Mix of commercial and residential development

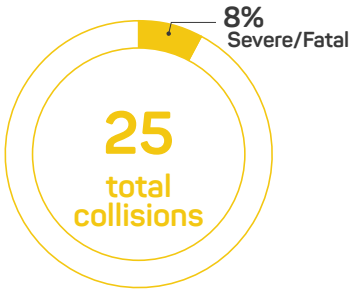
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	5	6
Signalized Intersection	5	3
Unsignalized Intersection	2	4
Total	**12**	**13**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

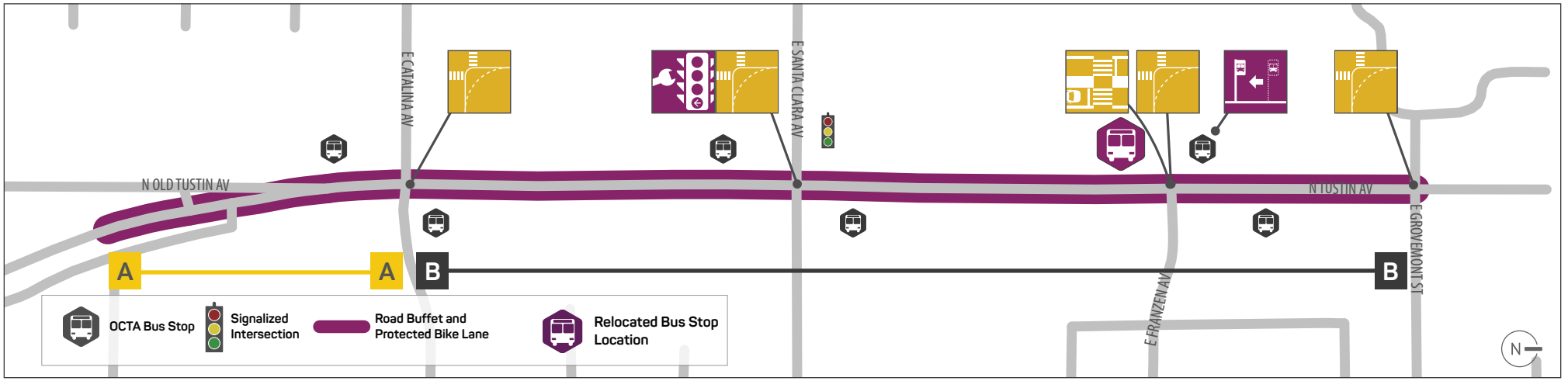
- Mix of signalized intersections and mid-block
- Collisions with through and left turning vehicles

Bicycle Collisions

- Mix of signalized, unsignalized and mid-block
- Wrong way riding

23 | TUSTIN AVENUE

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor.

- Road Buffet
- Curb Radius Reduction
- Median Refuge Island
- Protected Bike Lane
- Add Protected Left Turn Phase
- Relocate Transit Stop

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$825,000

Curb Radius Reduction	$	60,000
One-Way Protected Bike Lane	$	438,000
Median Refuge Island	$	30,000
Signal Timing Modifications	$	10,000
Speed Limit Reduction	$	500
Transit Stop	$	11,500
Engineering	$	82,500
Fees/Permits/Supervision	$	82,500
Contingencies	$	110,000

EXPECTED BENEFIT/COST RATIO

9.50

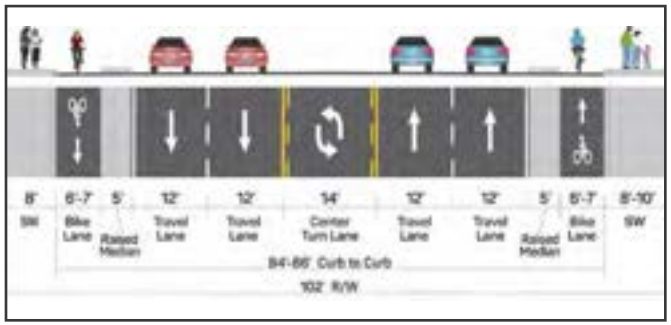
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

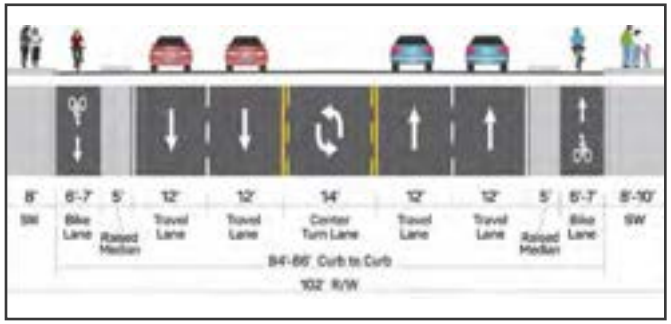
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

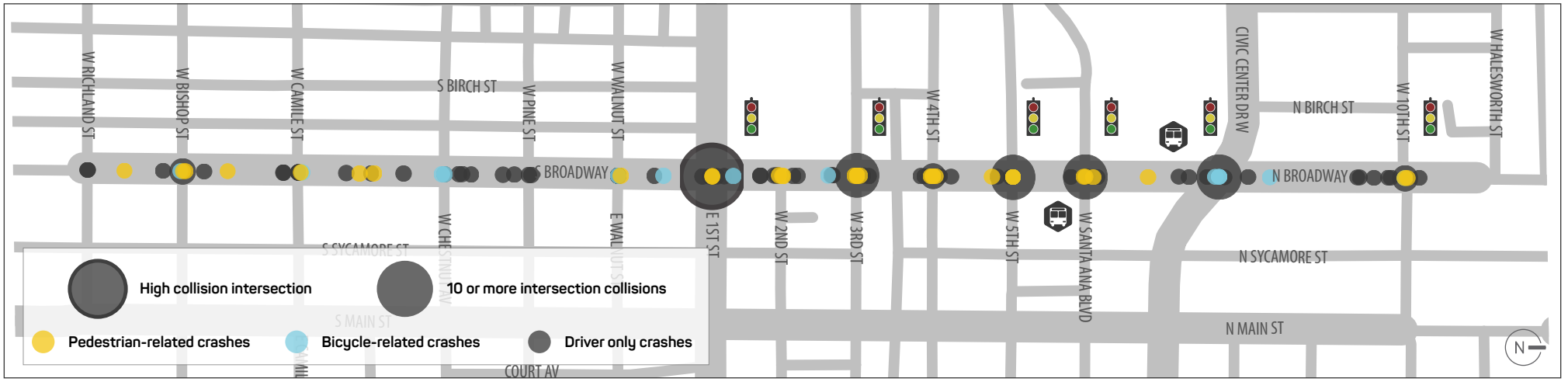


B



24 | BROADWAY FROM W HALESWORTH ST TO W RICHLAND ST

COLLISION HISTORY

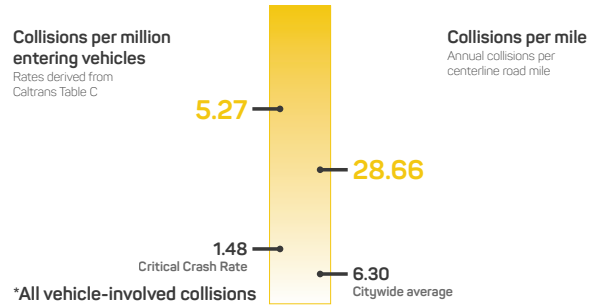


LOCATION DESCRIPTION

Broadway is characterized by a variety of commercial uses through downtown before transitioning to primarily residential to the south. There are a number of schools near the northern extent of this project. 1st is a high collision intersection for pedestrians.

Classification	Secondary Arterial / Collector
Posted Speed	30 - 35
Length (miles)	1.1
Number of Lanes	2 - 5
ADT	14,900
Schools	Lathrop Intermediate; Benjamin Franklin Elementary
Transit Lines	-
Major Generators	Downtown Santa Ana

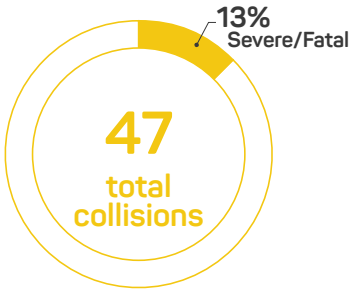
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	7	4
Signalized Intersection	18	6
Unsignalized Intersection	7	5
Total	**32**	**15**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

» More than 1/2 at signalized intersections

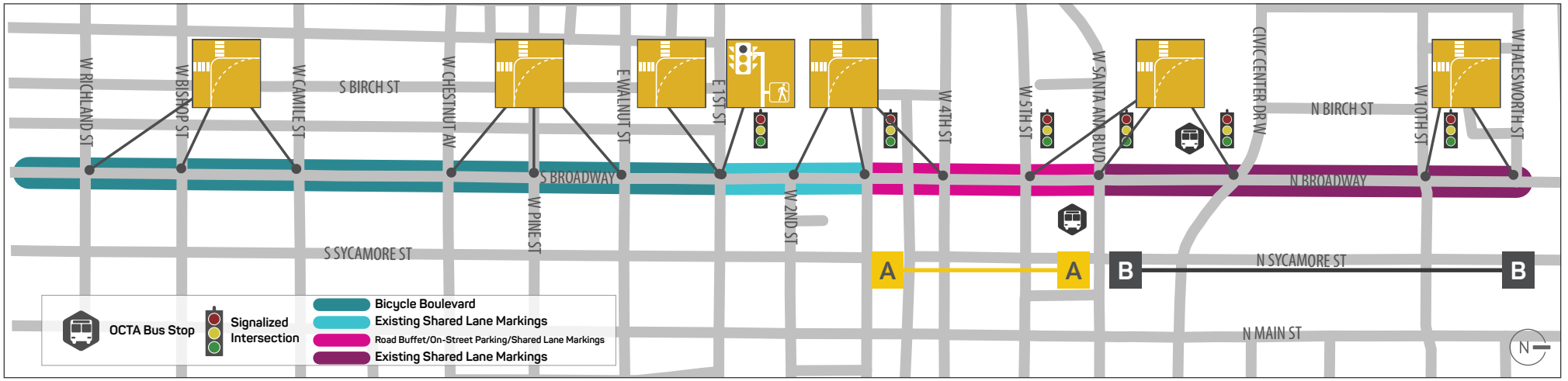
» Collisions with through and left turning vehicles

Bicycle Collisions

» Collisions with left and right turning vehicles

» Collisions at driveways

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequently involving pedestrians at signalized intersections. Pedestrian and bicycle amenities support decreased vehicle trips from proposed One Broadway Plaza development.


Road Buffet


Bicycle Boulevard


Leading Pedesterian Interval


Protected Bike Lane


Curb Radius Reduction


On-Street Parking

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$2,120,400

Curb Radius Reduction	$	195,000
Bicycle Boulevard	$	228,800
One-Way Protected Bike Lanes	$	511,000
Road Buffet (6 to 5 lanes)	$	227,500
Leading Pedestrian Intervals	$	1,300
Traffic Signal Modifications	$	250,000
Engineering	$	212,040
Fees/Permits/Supervision	$	212,040
Contingencies	$	282,720

EXPECTED BENEFIT/COST RATIO

7.41

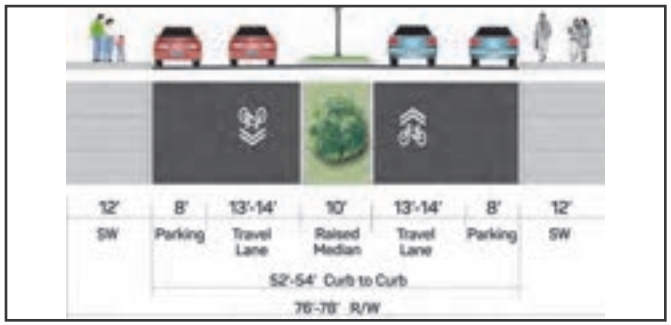
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

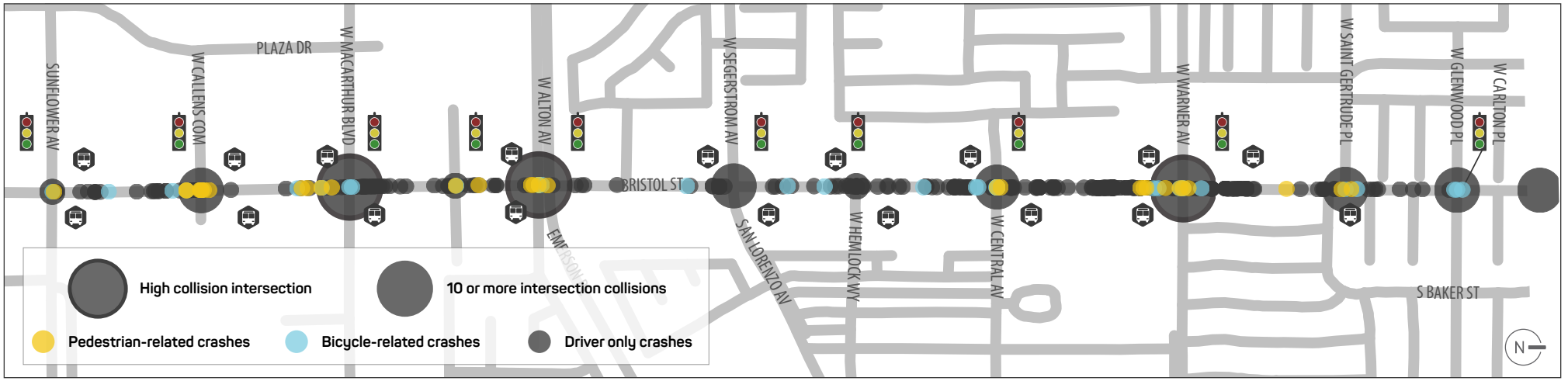
A



B

25 | BRISTOL STREET FROM GLENWOOD PLACE TO SUNFLOWER AVENUE

COLLISION HISTORY

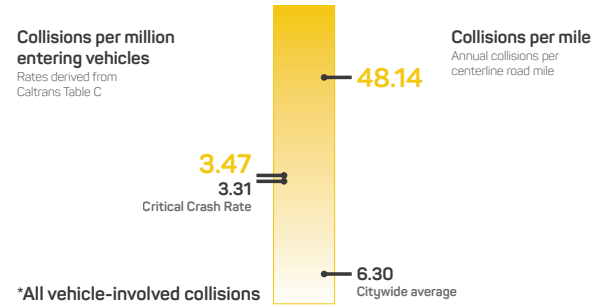


LOCATION DESCRIPTION

At the southern end of the city, collision patterns on Bristol reflect high levels of both pedestrian and bicycle activity on this wide corridor characterized by continuous commercial land uses, the #55 and #57 bus lines, and proximity to two elementary schools. Alton (pedestrian and bicycle) and Warner (bicycle) are high collision intersections.

Classification	Major Arterial
Posted Speed	40
Length (miles)	1.89
Number of Lanes	5 - 7
ADT	38,000
Schools	Thomas Jefferson Elementary; Jose Andres Sepulveda Elementary; Mater Dei High
Transit Lines	55, 57
Major Generators	South Coast Plaza; Coast Communities Hospital

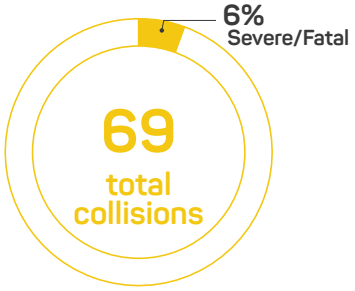
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	12	15
Signalized Intersection	16	23
Unsignalized Intersection	2	1
Total	**30**	**39**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

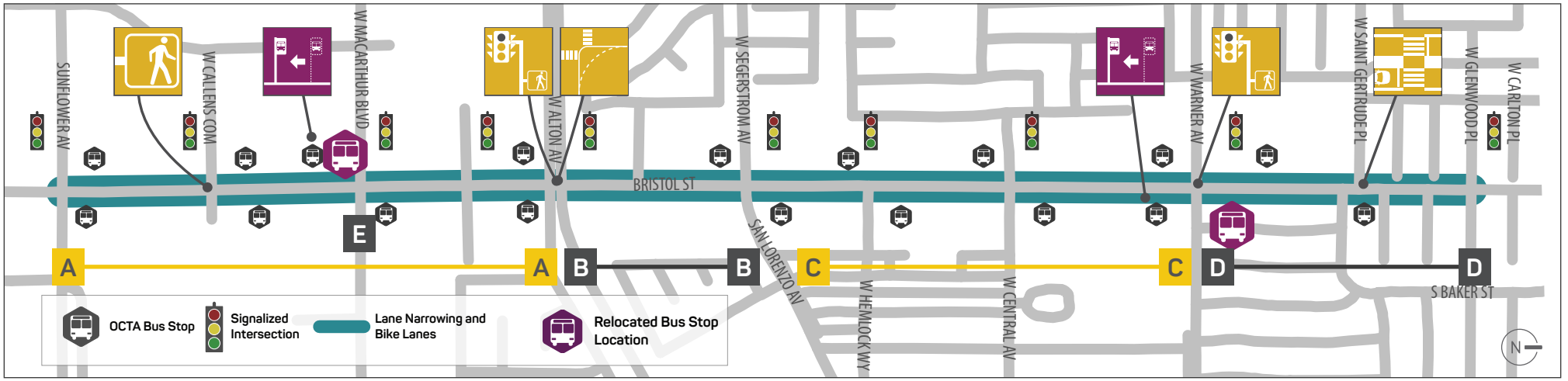
Pedestrian Collisions

- Signalized intersections and mid-block
- Through and turning vehicles

Bicycle Collisions

- Signalized intersections and mid-block
- Collisions at driveways and with right turning vehicles
- Wrong way riding

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions at signalized intersections and mid-block.

- Bike Lanes
- Leading Pedestrian Interval
- Pedesterian Recall
- Parallel Bicycle Boulevard
- Relocate Transit Stops
- Median Refuge Island
- Curb Radius Reduction

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$1,030,275

Curb Radius Reduction	$	3,750
Bike Lanes	$	304,000
Bicycle Boulevard	$	71,500
Median Refuge Island	$	30,000
Traffic Signal Modifications	$	252,600
Speed Limit Reduction	$	2,000
Transit Stop	$	23,000
Engineering	$	103,028
Fees/Permits/Supervision	$	103,028
Contingencies	$	137,370

EXPECTED BENEFIT/COST RATIO

18.46

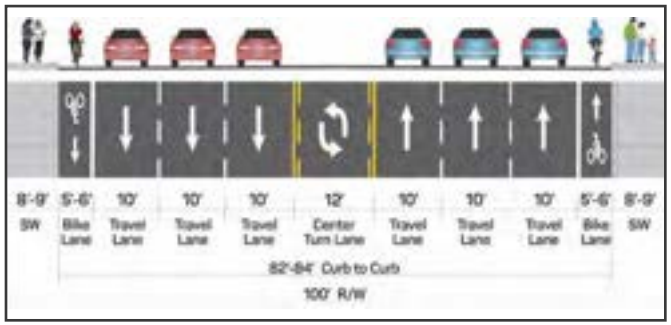
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

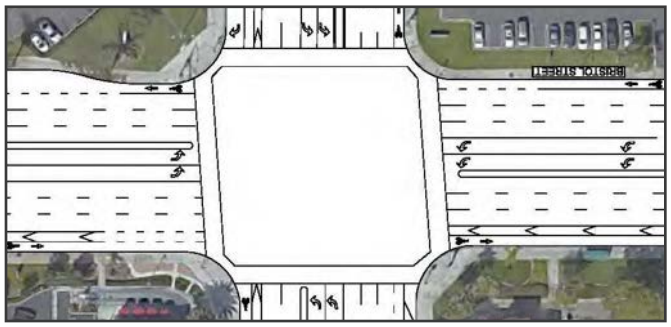
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

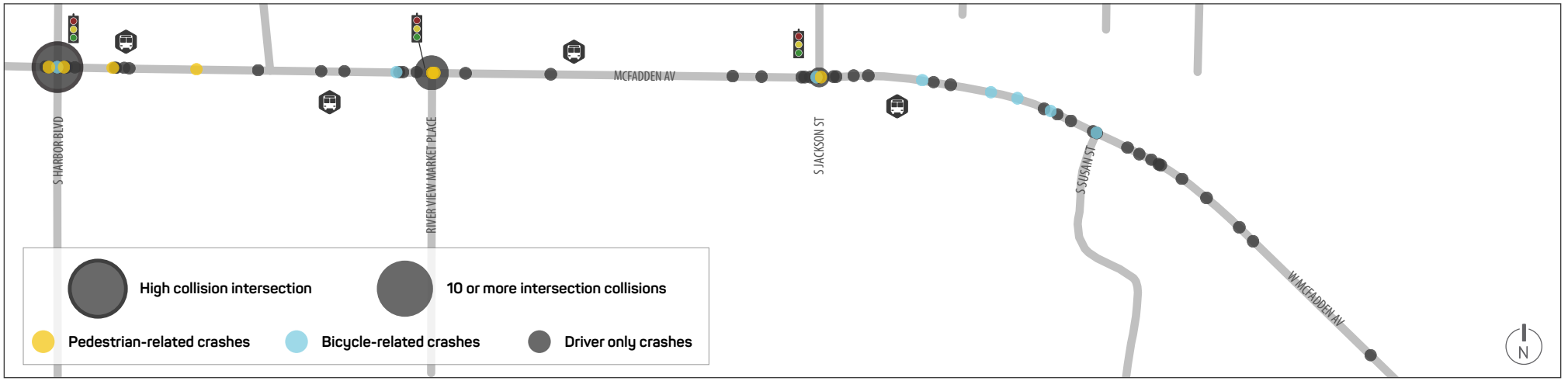


E



26 | MCFADDEN AVENUE FROM HARBOR BOULEVARD TO E OF S SUSAN ST

COLLISION HISTORY

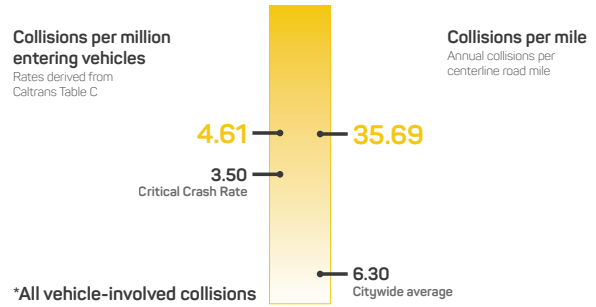


LOCATION DESCRIPTION

The distribution of bicycle and pedestrian collisions on McFadden between Harbor and the Santa Ana River is reflective of activity near large lot commercial on both sides of the street, Russel Elementary School, and the #66 bus line. Harbor is a high collision intersection for both pedestrians and bicyclists.

Classification	Secondary Arterial
Posted Speed	30
Length (miles)	0.5
Number of Lanes	5
ADT	21,200
Schools	Russell Elementary School
Transit Lines	76
Major Generators	Riverview West Marketplace; Walmart; Northgate Market

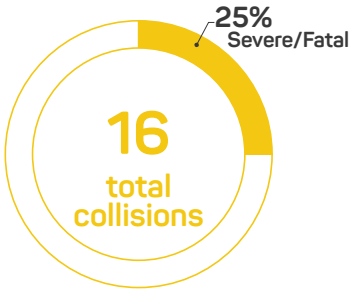
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	2	6
Signalized Intersection	3	2
Unsignalized Intersection	2	1
Total	**7**	**9**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

» Collisions with through moving vehicles

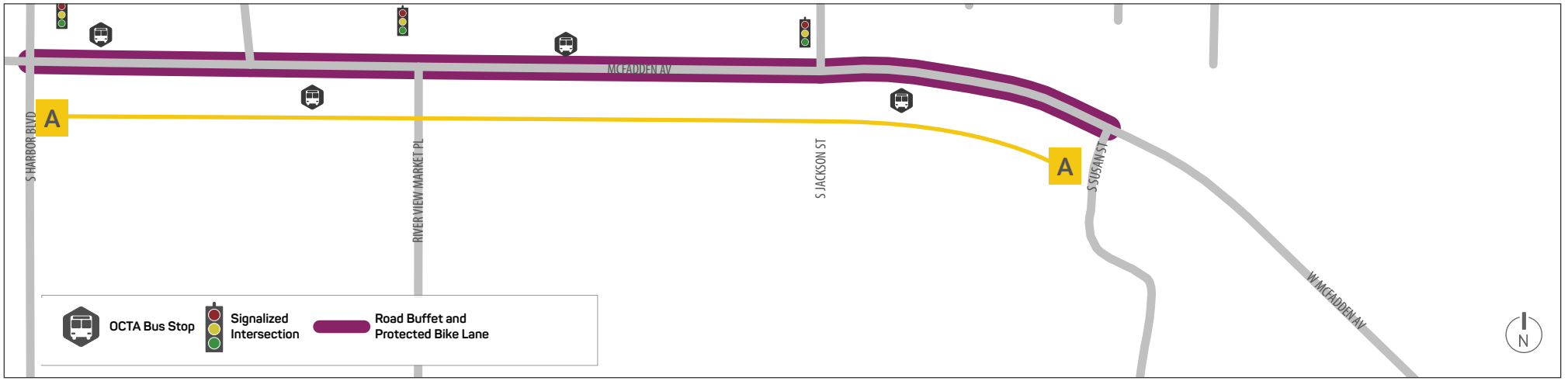
Bicycle Collisions

» 2/3 mid-block

» Collisions at driveways

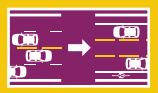
» Wrong way riding

SOLUTIONS

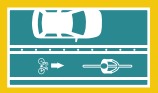


PROJECT DESCRIPTION

The recommendations respond to the prevalence of bicycle collisions at mid-block locations, including at driveways, as well as pedestrian collisions throughout.



Road Buffet



Protected Bike Lane

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$547,500

One-Way Protected Bike Lanes	$	365,000
Engineering	$	54,750
Fees/Permits/Supervision	$	54,750
Contingencies	$	73,000

EXPECTED BENEFIT/COST RATIO

0.87

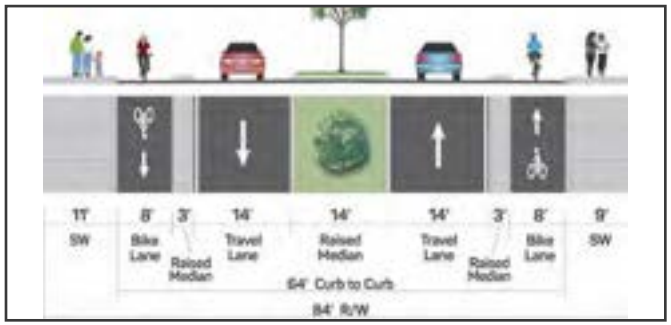
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

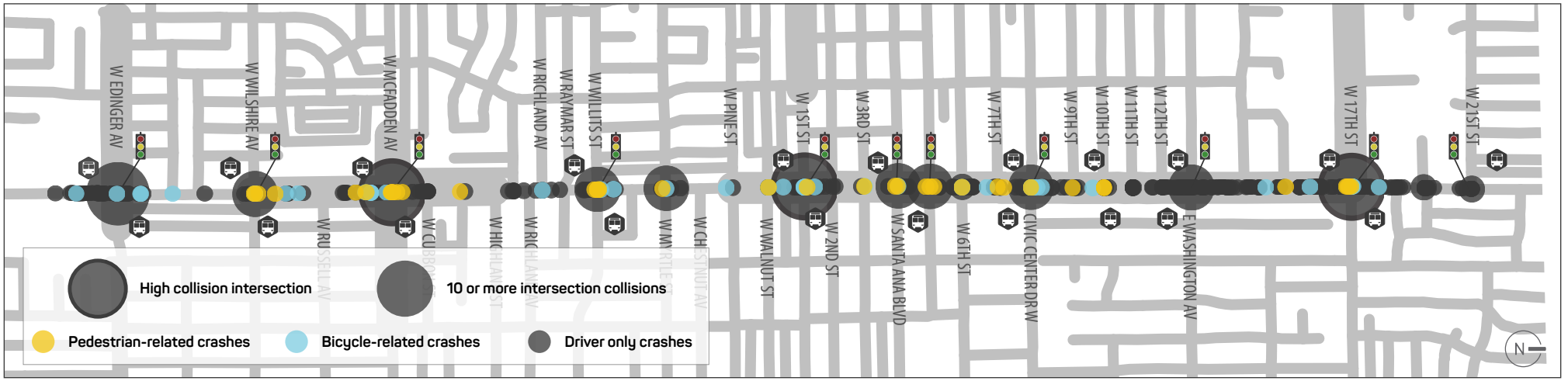
CROSS SECTIONS

A



27 | BRISTOL STREET FROM 21ST STREET TO S OF EDINGER AVENUE

COLLISION HISTORY

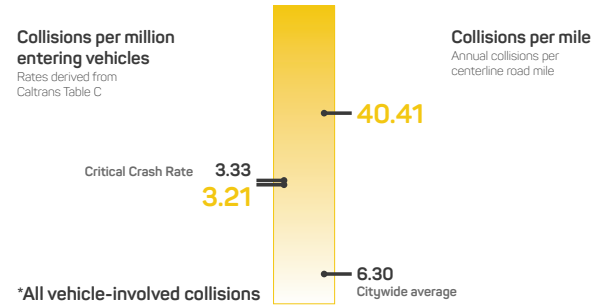


LOCATION DESCRIPTION

Collision patterns on Bristol through the heart of the city reflect high levels of both pedestrian and bicycle activity on this wide corridor characterized by continuous commercial land uses, the #57 bus line, and proximity to five elementary schools. 17th (pedestrian and bicycle), 1st (pedestrian and bicycle) and McFadden (pedestrian) are high collision intersections.

Classification	Major Arterial
Posted Speed	30 - 40
Length (miles)	2.61
Number of Lanes	5 - 6
ADT	34,500
Schools	Jose Andres Sepulveda Elementary; Mater Dei High; Dr. MLK Jr. Elementary; Lydia Romero-Cruz Elementary; Heroes Elementary; Wilson Elementary
Transit Lines	57
Major Generators	Santa Ana College; Bristol Marketplace; Kindred Hospital Santa Ana

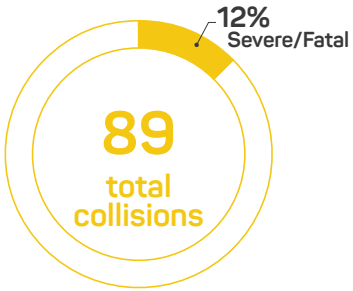
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	7	20
Signalized Intersection	26	22
Unsignalized Intersection	8	6
Total	**41**	**48**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

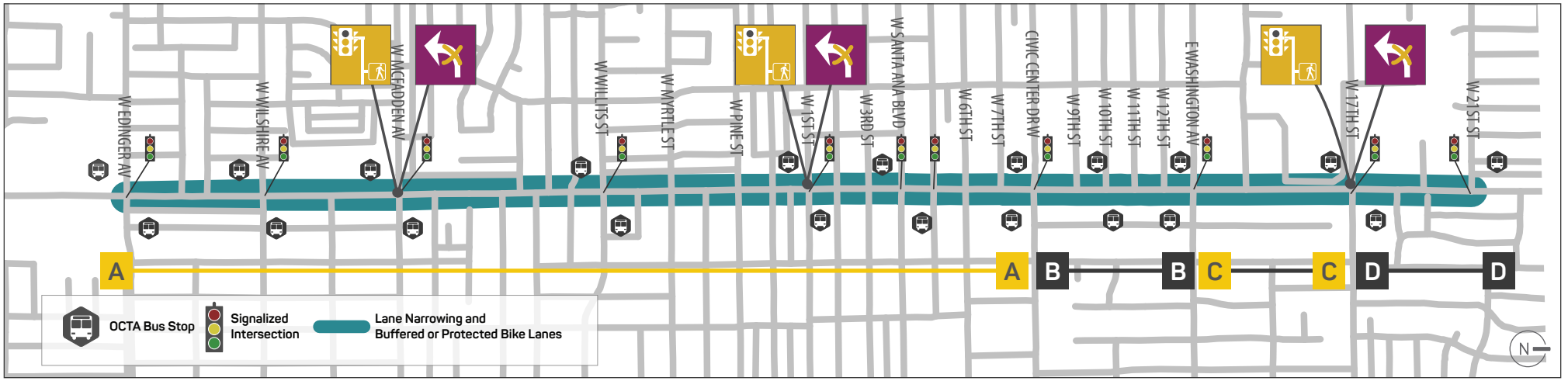
Pedestrian Collisions

- Nearly 2/3 at signalized intersections
- Collisions with turning vehicles

Bicycle Collisions

- Mid-block and signalized intersections
- Collisions at driveways and with right turning vehicles
- Wrong way riding

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions at signalized intersections and mid-block.

- Buffered or Protected Bike Lanes
- Parallel Bicycle Boulevard
- Leading Pedestrian Intervals
- Lane Narrowing
- Remove Turn Lanes
- Monitor Speeds and Collisions

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$1,937,700

Bike Lanes	$	12,000
Bicycle Boulevard	$	371,800
Median Refuge Island	$	90,000
Leading Pedestrian Intervals	$	13,000
Speed Limit Reduction	$	2,500
Traffic Signal Modifications	$	375,000
Buffered Bike Lane	$	427,500
Engineering	$	193,770
Fees/Permits/Supervision	$	193,770
Contingencies	$	258,360

EXPECTED BENEFIT/COST RATIO

24.80

Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

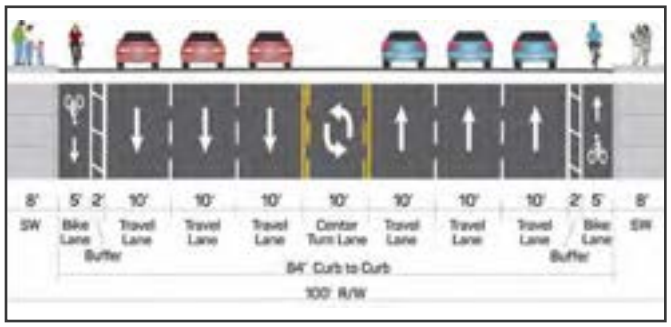
The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

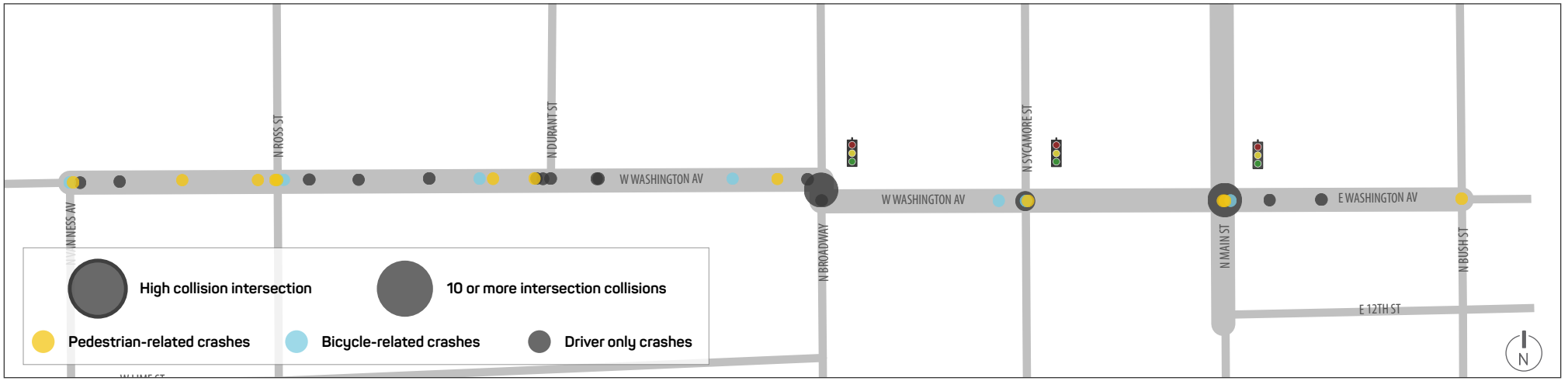
A

C



28 | WASHINGTON AVENUE FROM N VAN NESS AV TO N BUSH ST

COLLISION HISTORY

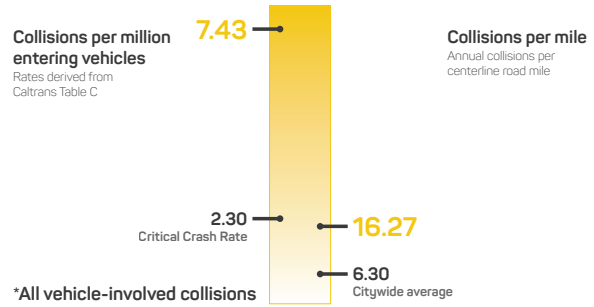


LOCATION DESCRIPTION

The distribution of collisions on Washington reflects pedestrian crossing activity, particularly away from signalized intersections in the vicinity of Willard Intermediate School, as well as bicycle activity in this corridor near downtown.

Classification	No Data - Local
Posted Speed	25
Length (miles)	0.42
Number of Lanes	no data
ADT	6,000
Schools	Willard Intermediate
Transit Lines	-
Major Generators	-

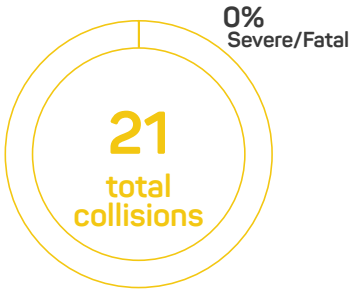
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	3	0
Signalized Intersection	3	3
Unsignalized Intersection	6	6
Total	**12**	**9**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

» 1/2 at unsignalized intersections

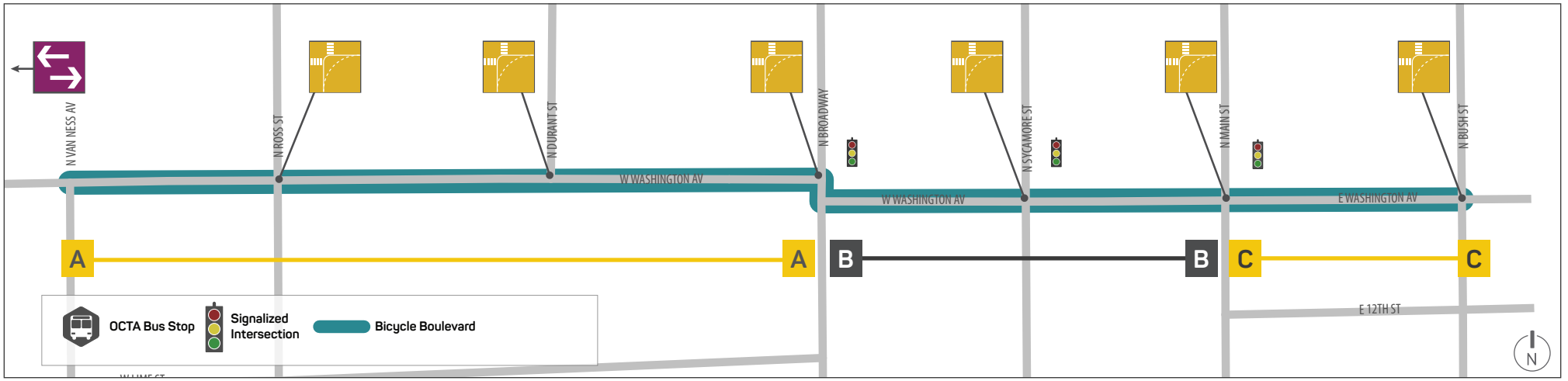
» 1/4 mid-block

» Collisions with through vehicles

Bicycle Collisions

» 2/3 at unsignalized intersection

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of bicycle collisions and collisions involving pedestrians crossing far from signalized crossing opportunities. The recommendations include a connection to the Santa Ana River Trail (west of the project extent) and wayfinding to direct users to the trail.

Bicycle Boulevard

Connection to Santa Ana River Trail and Wayfinding

Curb Radius Reduction

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$725,010

Curb Radius Reduction	$	82,500
Bicycle Boulevard	$	400,400
Regulatory and Warning Sign	$	440
Engineering	$	72,501
Fees/Permits/Supervision	$	72,501
Contingencies	$	96,668

EXPECTED BENEFIT/COST RATIO

0.34

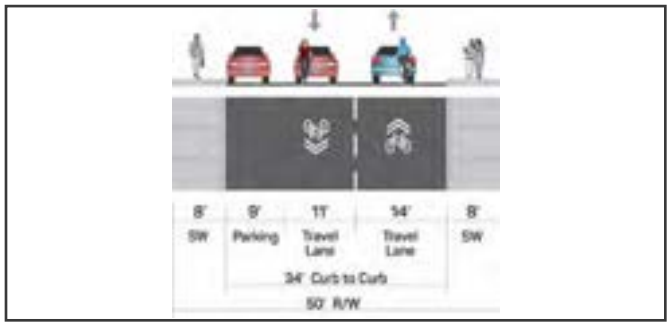
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

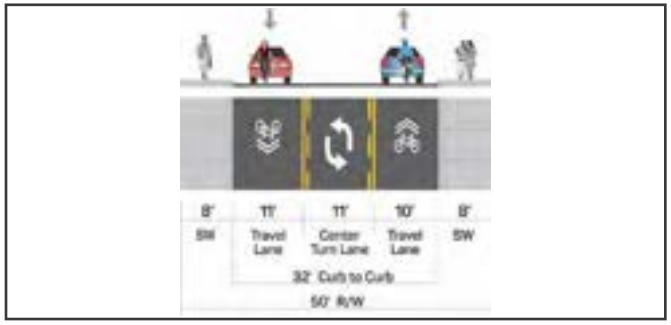
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

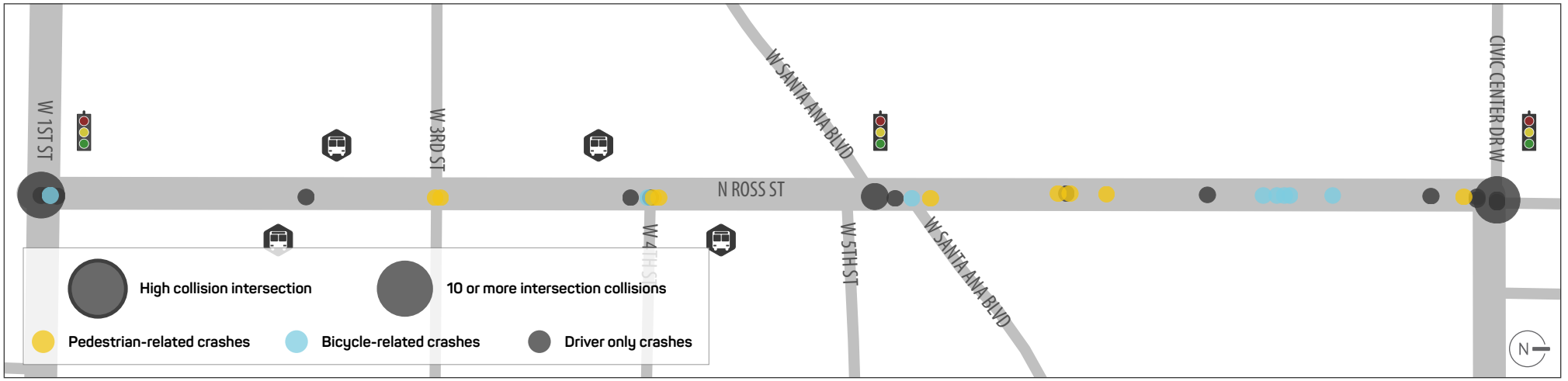


B



30 | ROSS STREET FROM CIVIC CENTER DR W TO W 1ST ST

COLLISION HISTORY

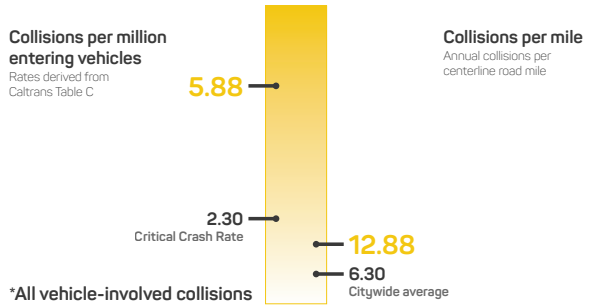


LOCATION DESCRIPTION

The distribution of pedestrian and bicycle collisions along Ross through downtown reflects activity from a variety of civic buildings, including Santa Ana Civic Center and the Santa Ana Public Library, as well as the #55 bus line.

Classification	No Data - Local
Posted Speed	25
Length (miles)	0.42
Number of Lanes	no data
ADT	6,000
Schools	-
Transit Lines	55
Major Generators	Federal Building and US Courthouse; Santa Ana Civic Center; Santa Ana Public Library

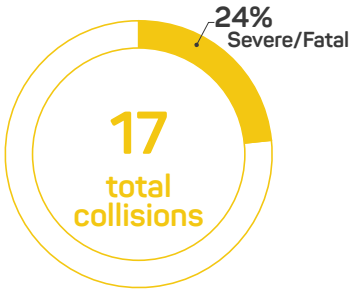
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	3	5
Signalized Intersection	2	2
Unsignalized Intersection	4	1
Total	**9**	**8**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

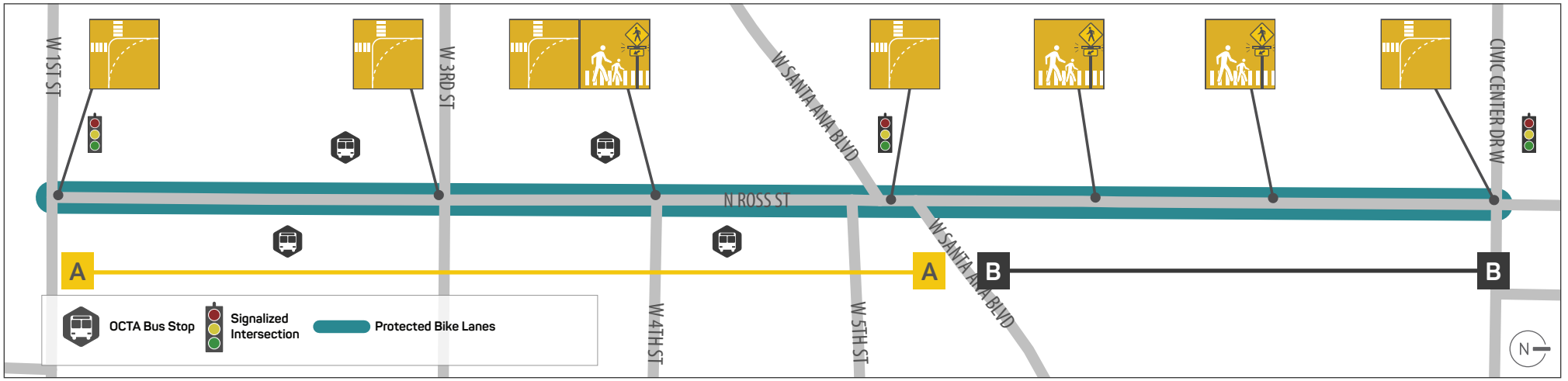
Pedestrian Collisions

- » Mix of unsignalized and mid-block locations
- » Collisions with through vehicles

Bicycle Collisions

- » More than 2/3 mid-block
- » Collisions at driveways

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor.

Protected Bike Lanes

Enhanced Crossing

Curb Radius Reduction

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$1,114,200

Curb Radius Reduction	$	75,000
One-Way Protected Bike Lanes	$	292,000
Curb Extension	$	40,600
Rectangular Flashing Beacons	$	85,200
Traffic Signal Modification	$	250,000
Engineering	$	111,420
Fees/Permits/Supervision	$	111,420
Contingencies	$	148,560

EXPECTED BENEFIT/COST RATIO

23.44

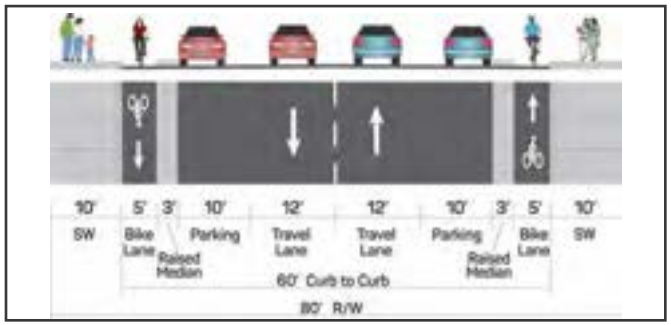
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

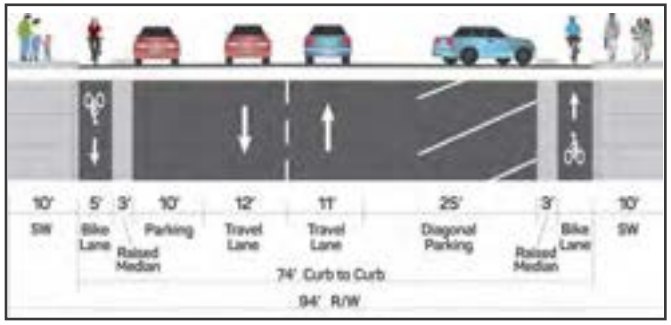
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A

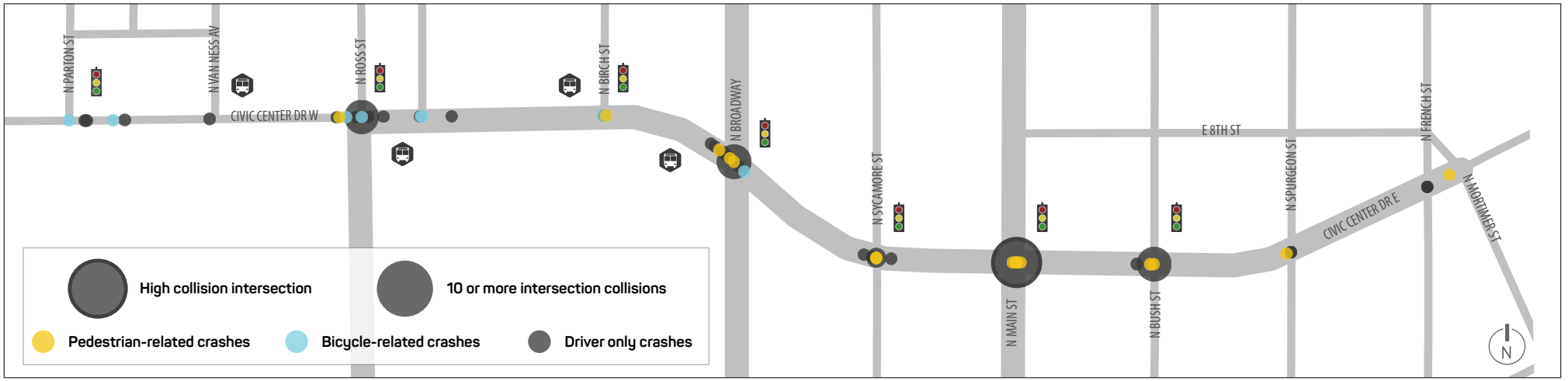


B



31 | CIVIC CENTER DRIVE FROM N PARTON ST TO MORTIMER STREET

COLLISION HISTORY

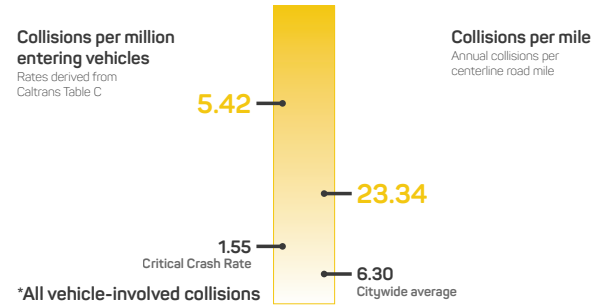


LOCATION DESCRIPTION

The distribution of pedestrian and bicycle collisions along Civic Center through downtown reflects activity from a variety of civic buildings, including Santa Ana Civic Center, Santa Ana Public Library, Santa Ana Stadium, and the #83 and #462 bus lines. Main is a high collision intersection for pedestrians.

Classification	Secondary Arterial
Posted Speed	30 - 35
Length (miles)	0.63
Number of Lanes	4 - 5
ADT	11,800
Schools	-
Transit Lines	83, 462
Major Generators	Santa Ana Stadium; Santa Ana Civic Center; Santa Ana Public Library

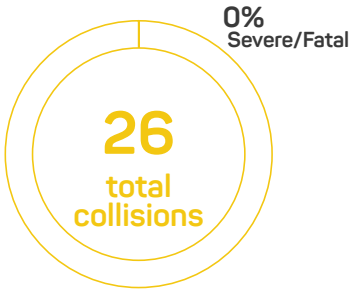
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	2	2
Signalized Intersection	13	7
Unsignalized Intersection	1	1
Total	**16**	**10**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

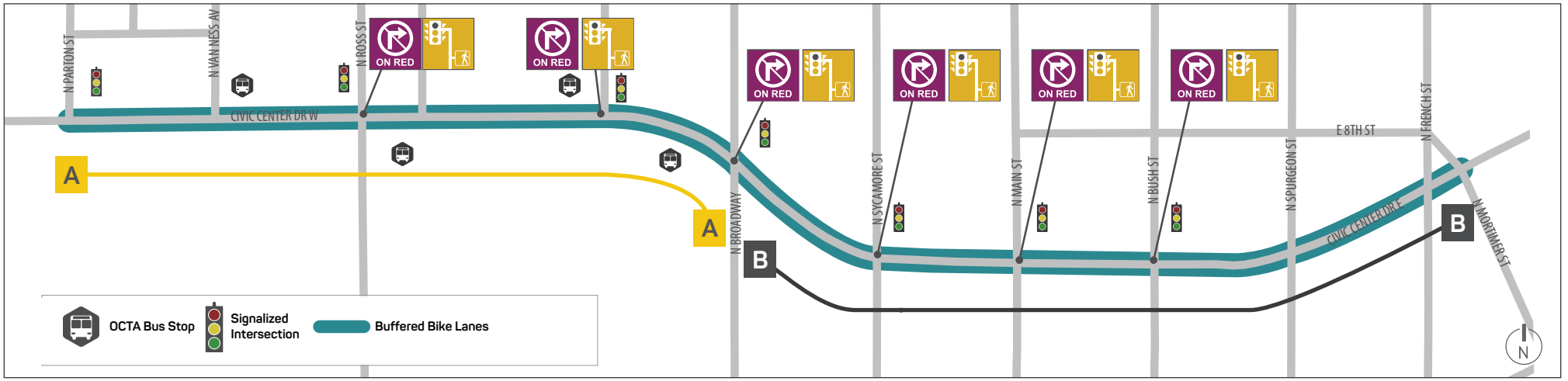
» Nearly all at signalized intersections

» Collisions with turning vehicles vehicles

Bicycle Collisions

» Nearly all at signalized intersections

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequently at signalized intersections.

- Buffered Bike Lanes
- Leading Pedestrian Intervals
- Restrict Right Turn on Red
- Speed Monitoring

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$119,010

Buffered Bike Lanes	$	68,400
Leading Pedestrian Intervals	$	7,800
Regulatory and Warning Sign	$	2,640
Speed Limit Reduction	$	500
Engineering	$	11,901
Fees/Permits/Supervision	$	11,901
Contingencies	$	15,868

EXPECTED BENEFIT/COST RATIO

15.54

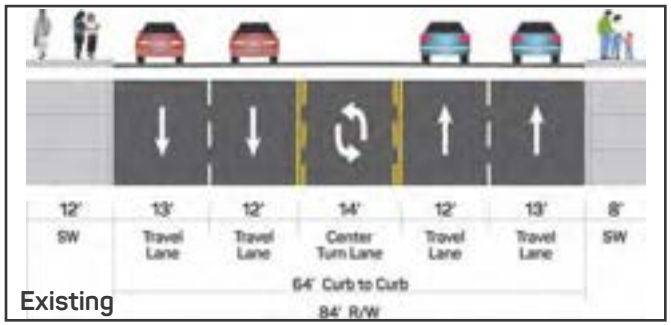
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

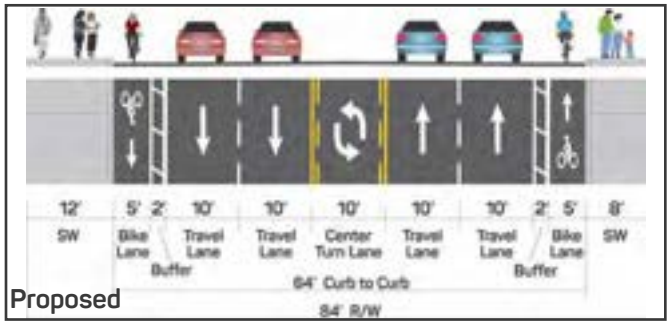
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

B

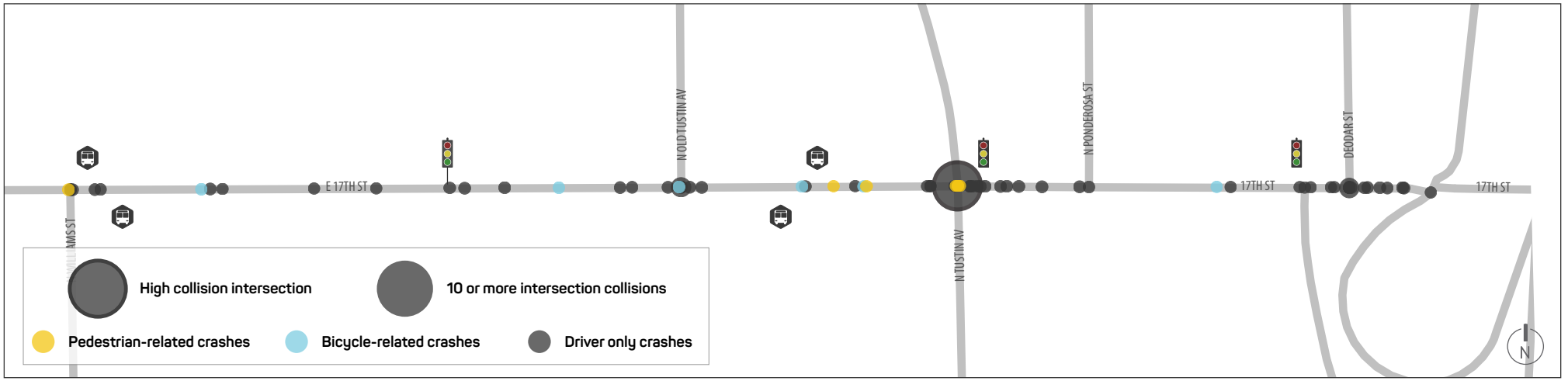


B



32 | 17TH STREET FROM WILLIAMS STREET TO ROUTE 55

COLLISION HISTORY

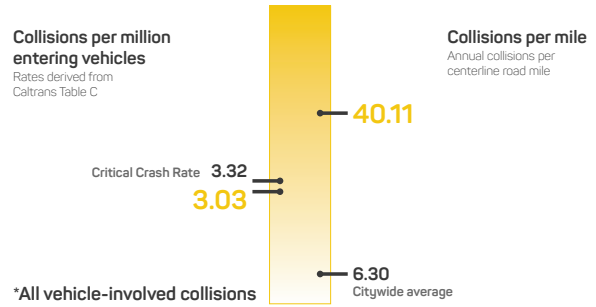


LOCATION DESCRIPTION

At the eastern city limits, the distribution of collisions on 17th reflects bicycle and pedestrian activity associated with continuous commercial development and the #60 bus line. Tustin is a high collision intersection for pedestrians.

Classification	Major Arterial
Posted Speed	40
Length (miles)	0.43
Number of Lanes	6
ADT	36,300
Schools	-
Transit Lines	60
Major Generators	Orange County Global Medical Center

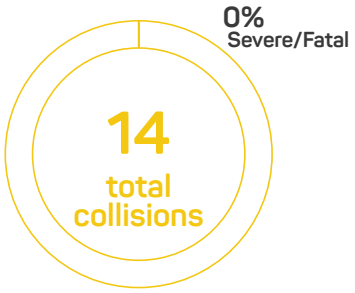
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	2	5
Signalized Intersection	5	0
Unsignalized Intersection	1	1
Total	**8**	**6**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

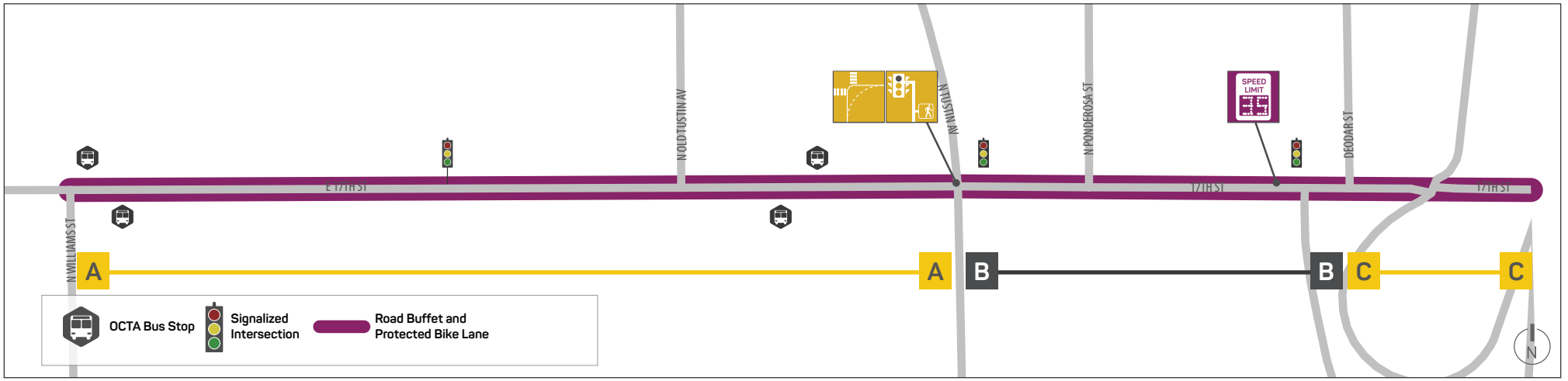
» More than 2/3 at signalized intersections

Bicycle Collisions

» More than 2/3 mid-block

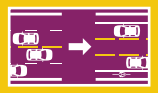
» Collisions at driveways

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of both pedestrian and bicycle collisions along this corridor, frequently at signalized intersections for pedestrians and mid-block including driveways for bicycles.


Road Buffet


Curb Radius Reduction

Variable Speed Sign


Protected Bike Lanes


Leading Pedestrian Intervals

CONSISTENCY CONSIDERATIONS

If it can be demonstrated that proposed lane assignments can accommodate existing and future volumes, temporary reconfiguration may be permitted. Board consideration is required to grant exceptions due to overriding and documented safety concerns.

COST ESTIMATE

$1,117,950

Curb Radius Reduction	$	45,000
One-Way Protected Bike Lanes	$	292,000
Traffic Signal Modifications	$	376,300
Speed Limit Reduction/Feedback Sign	$	20,500
Transit Stop	$	11,500
Engineering	$	111,795
Fees/Permits/Supervision	$	111,795
Contingencies	$	149,060

EXPECTED BENEFIT/COST RATIO

1.48

Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

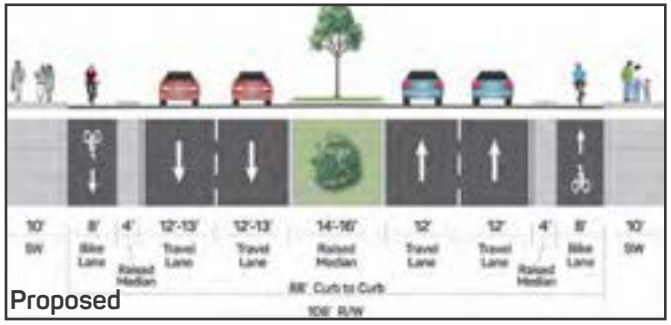
The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

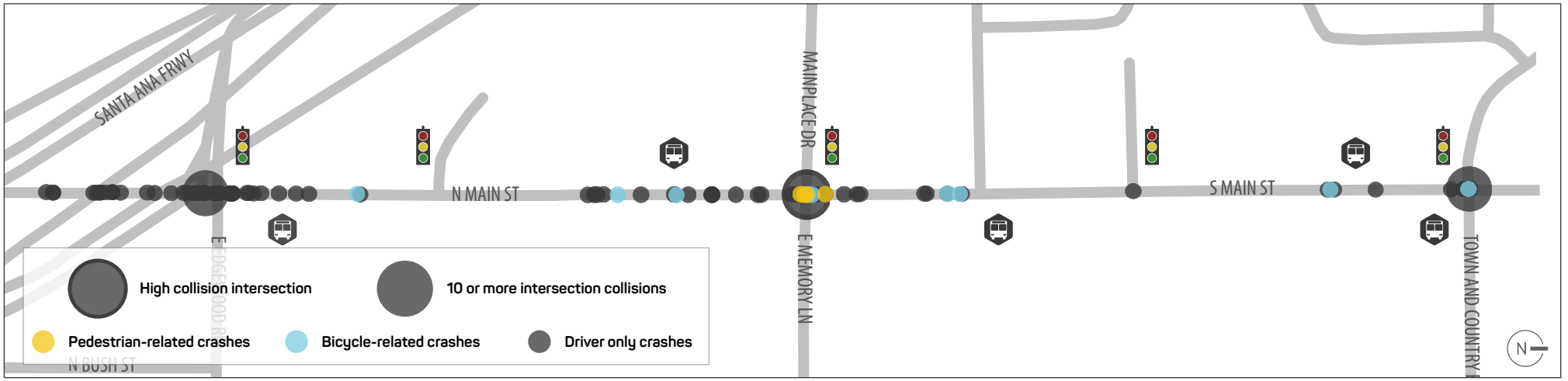
A

A



34 | MAIN STREET FROM TOWN AND COUNTRY ROAD TO I-5

COLLISION HISTORY

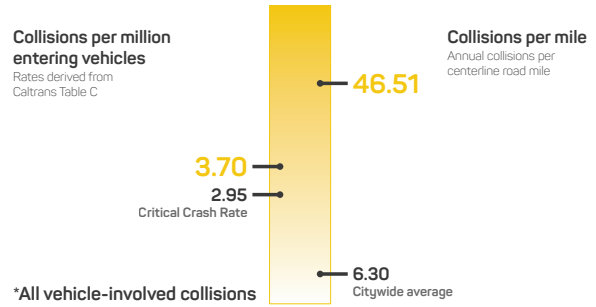


LOCATION DESCRIPTION

The distribution of collisions on Main north of I-5 reflects bicycle activity in an area with few opportunities to cross multiple freeways. Mainplace Drive is a high collision intersection for pedestrians.

Classification	Major Arterial
Posted Speed	35
Length (miles)	0.57
Number of Lanes	6
ADT	34,400
Schools	CNI College
Transit Lines	53
Major Generators	Main Place

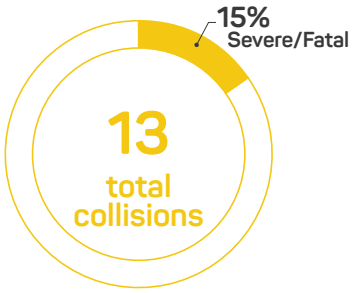
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	1	6
Signalized Intersection	3	3
Unsignalized Intersection	0	0
Total	**4**	**9**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

Pedestrian Collisions

» Collisions at Mainplace Drive

Bicycle Collisions

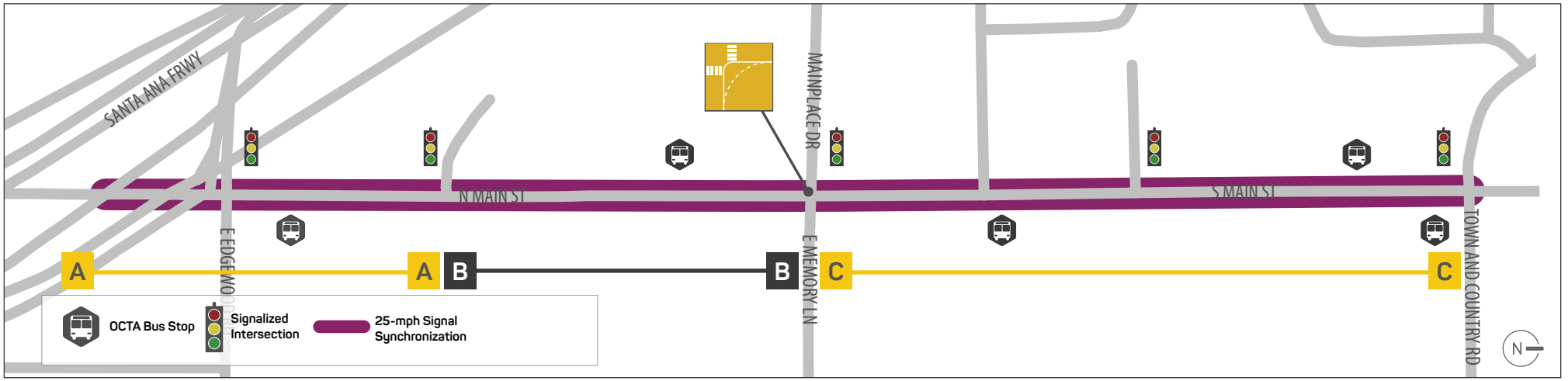
» 2/3 mid-block

» Collisions with right turning vehicles

» Collisions at driveways

» Wrong way riding

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to a prevalence of bicycle collisions along a corridor that provides access across multiple freeways.

Signal Synchronization

Curb Radius Reduction

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$15,375

Curb Radius Reduction	$	3,750
Signal Timing Modifications	$	6,500
Engineering	$	1,538
Fees/Permits/Supervision	$	1,538
Contingencies	$	2,050

EXPECTED BENEFIT/COST RATIO

18.22

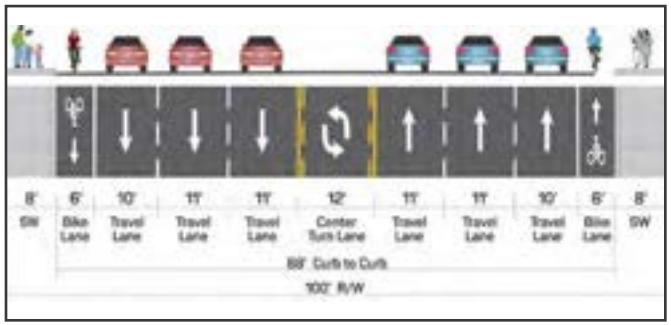
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

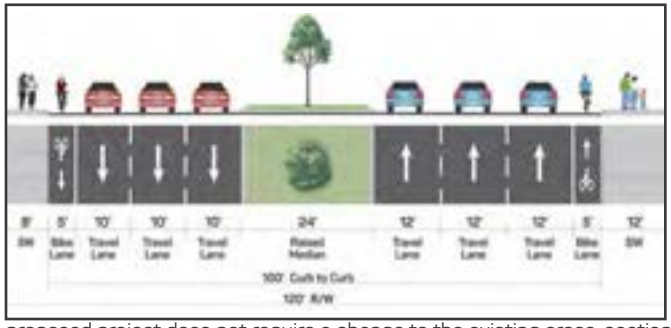
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A



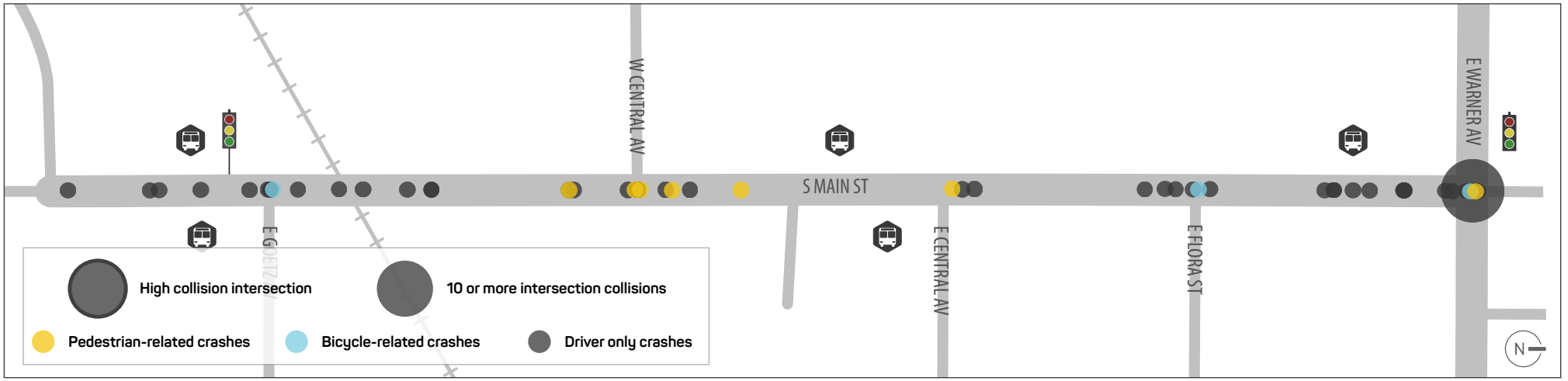
B



Note - The proposed project does not require a change to the existing cross-section. The cross-sections shown illustrate how a road buffet could allow for adding bicycle facilities, if speeds and collisions don't decrease sufficiently.

37 | MAIN STREET FROM WARNER AVENUE TO S OF GOETZ AVENUE

COLLISION HISTORY

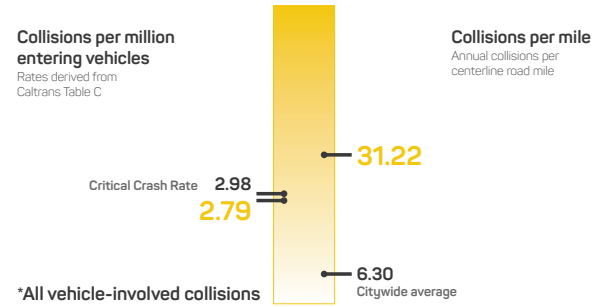


LOCATION DESCRIPTION

The distribution of collisions on Main between Warner and the railroad tracks reflects pedestrian crossing demand away from signalized intersections, including in the vicinity of the #53 bus stops near Central. This corridor has a variety of auto oriented employment to the west and is also near two elementary schools.

Classification	Major Arterial
Posted Speed	45
Length (miles)	0.39
Number of Lanes	6
ADT	30,600
Schools	Esqueda Elementary School, Washington Elementary School
Transit Lines	53
Major Generators	-

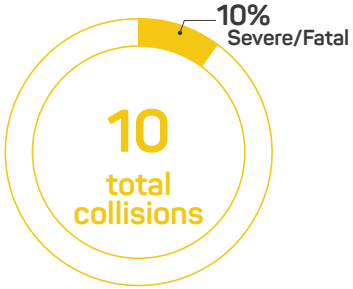
COLLISION RATES*



BICYCLE AND PEDESTRIAN COLLISIONS

Location Type	Ped	Bike
Mid-Block	2	0
Signalized Intersection	1	2
Unsignalized Intersection	4	1
Total	**7**	**3**

PERCENT SEVERE OR FATAL PEDESTRIAN/BIKE COLLISIONS



NOTABLE COLLISION PATTERNS

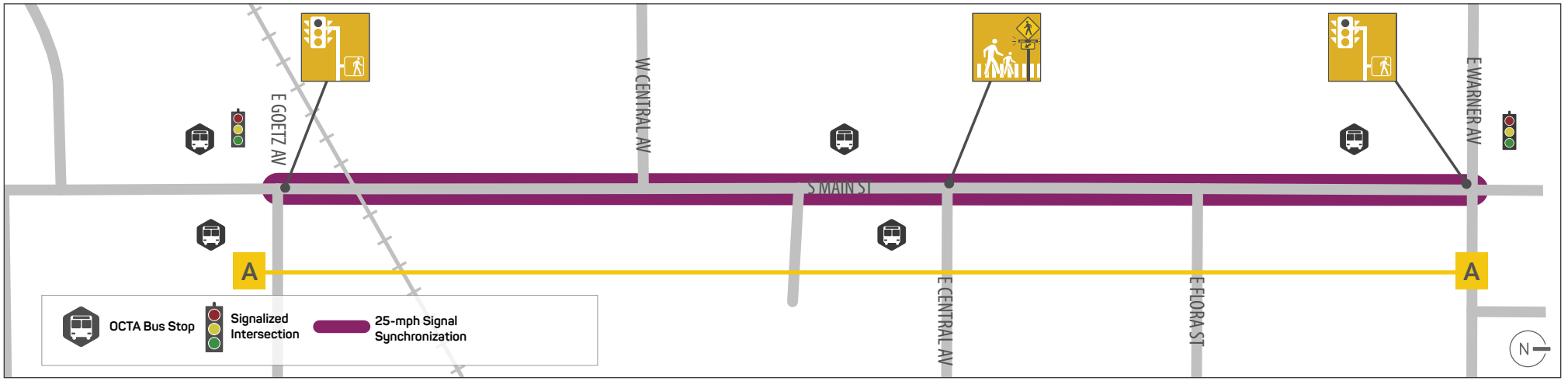
Pedestrian Collisions

» Collisions at unsignalized intersections

Bicycle Collisions

» N/A (3 collisions)

SOLUTIONS



PROJECT DESCRIPTION

The recommendations respond to the prevalence of pedestrian collisions far from signalized crossing opportunities, including in the vicinity of opposing bus stops near Central.

Signal Synchronization

Leading Pedestrian Interval

Enhanced Crossing

CONSISTENCY CONSIDERATIONS

None

COST ESTIMATE

$52,800

Leading Pedestrian Intervals	$	2,600
Signal Timing Modification	$	2,600
Roadway Lighting	$	30,000
Engineering	$	5,280
Fees/Permits/Supervision	$	5,280
Contingencies	$	7,040

EXPECTED BENEFIT/COST RATIO

45.97

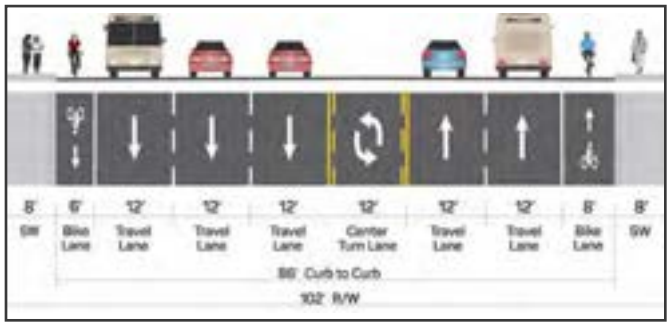
Calculations were conducted using SWITRS data input to the 2016 TIMS Berkeley Benefit Cost Calculator.

The benefit cost (BC) calculations provide an order of magnitude estimate and do not include the cost of Property Damage Only collisions. Detailed BC ratios will be completed for project grant applications.

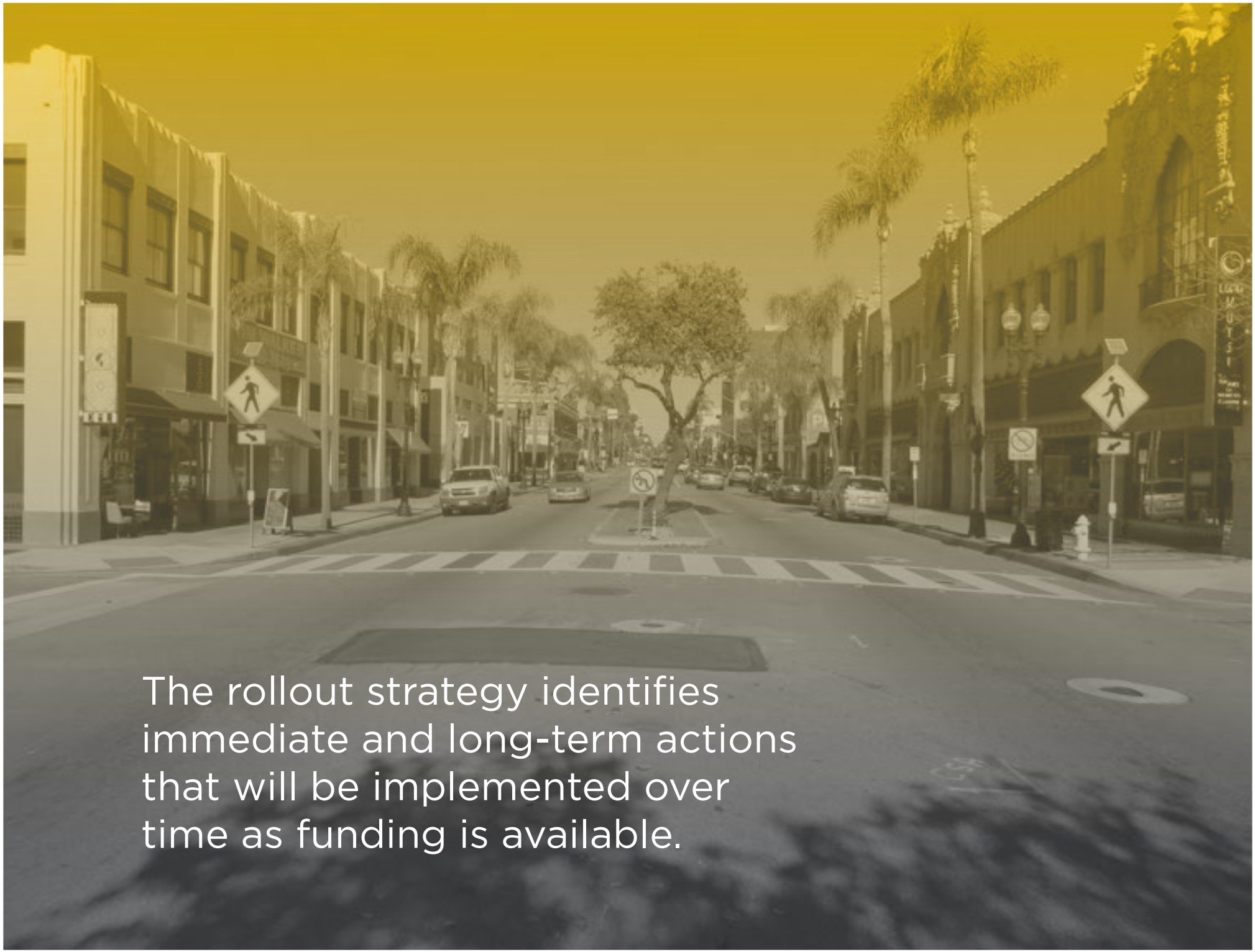
Only collisions within proximity of the intersection are applied for consideration of the intersection-related collision reduction factors.

CROSS SECTIONS

A



Note - The proposed project does not require a change to the existing cross-section. The cross-section shown illustrates how a road buffet could allow for adding bicycle facilities, if speeds and collisions don't decrease sufficiently.



The rollout strategy identifies immediate and long-term actions that will be implemented over time as funding is available.

5

ROLLOUT STRATEGY

The size and mix of safety strategies will depend upon the ability to identify new sustainable funding sources.

The intent is to begin immediately with those things that can be accomplished as part of normal operations, SMART, or by using existing grant and program resources.

The table on the following page illustrates a phased approach to funding the implementation of safety and education programs, safety campaign development and advertising, and infrastructure projects, in 2016 dollars. No capital or hard costs are expected for Police Department support.

Additional staff are recommended for the Public Works and Police Departments in both the moderate and aggressive scenarios. Two new Public Works staff, (including a Safety Coordinator and Education/Outreach position) at a cost of $200,000 per FTE per year should be dedicated to coordinating the efforts of the citywide safety program and leading in-community education efforts. For the Police Department, the increased enforcement and participation in safety campaigns will require additional officers. The costs of adding staff are assumed to be phased in beginning in Year 3, with an ultimate increase to 12.45 FTEs by 2031 (14 years) at a cost of $104,000 per FTE per year.

» The immediate baseline phasing assumes no additional cost to the city beyond that which is already undertaken, such as applying for infrastructure and programs grants and using existing social

media. Baseline infrastructure projects include signal modifications, installation of semi-permanent materials, signs, and transit stop relocation. Existing education efforts would be continued.

» The moderate scenario is recommended based on an assumption that infrastructure along the highest collision corridors is constructed, and moderate safety and enforcement campaigns are undertaken. Moderate projects include road narrowings, buffered bike lanes, and curb ramp projects funded by SMART. As many of the projects will require OCTA coordination regarding reclassification, and subsequent grant pursuits and design, these projects are anticipated to be completed in a five to seven year time frame.

» The aggressive scenario assumes that all infrastructure recommendations are constructed and the optimal safety and enforcement campaign is implemented. Infrastructure projects include CIP projects such as full signals, extensive curb work, and drainage. The execution of this scenario could take up to 20 years.

The facility modifications on the following table describe total infrastructure project costs in 2016 dollars. The table includes process and outcome, as well as whether the modification is expected to utilize SMART or Capital Funds.

Projects identified as eligible for SMART funds include lane narrowing, road buffets, intersection enhancements, or operational modifications that can be completed without substantial curb work. As more funds become available, the larger investments will be possible.

It should be noted that this total reflects only the SAMSA project costs. Full implementation of the Proposed Active Transportation Network will require additional funding.

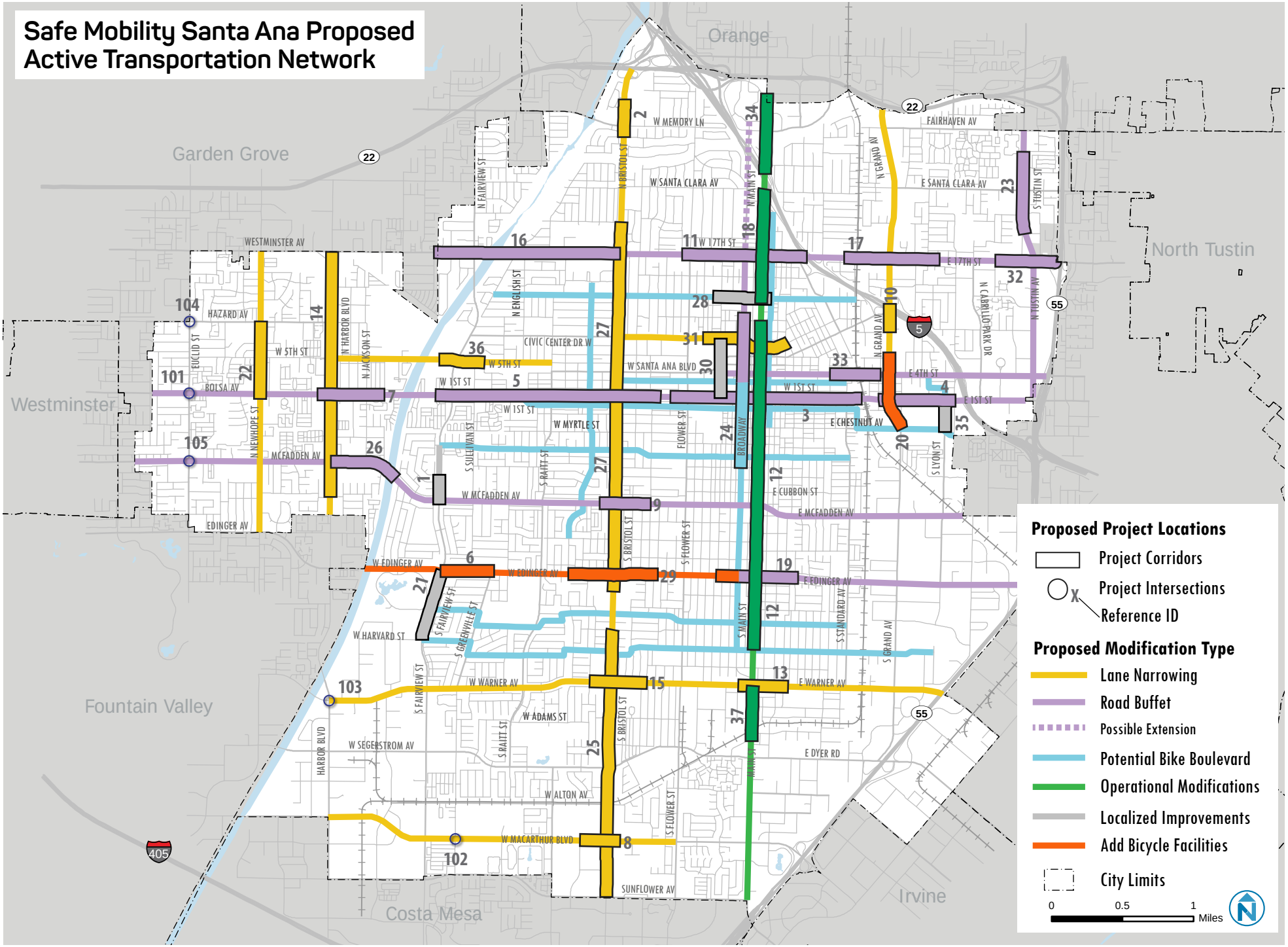
CAPITAL AND PROGRAM COSTS	BASELINE YEARS 1-2	MODERATE YEARS 3-7	AGGRESSIVE YEARS 8-14
Safety and Education Campaign			
School Based Education			
Local Messaging and Branding		$150,000	
Targeted Buys and Print and Social Media Distribution	$24,000	$208,175	$966,925
Public Works Programs and Infrastructure			
SMART Projects	$1,977,547	$4,943,867	$5,932,641
Capital Improvement Project Delivery		$8,765,170	$17,530,340
TOTAL COSTS			
Costs (2016 dollars)	$2,001,547	$14,067,212	$24,429,906
Per Year Costs (2016 dollars)	$1,000,773	$2,813,442	$3,489,987
Total Costs (2016 dollars)			**$40,498,665**

FACILITY MODIFICATIONS	SMART ELIGIBLE	CAPITAL PROJECTS	GRAND TOTAL
Add Bicycle Facilities			
Bike lanes	$129,600		$129,600
Buffered bike lanes	$597,900		$597,900
Protected bike lanes		$1,381,950	$1,381,950
Lane Narrowing			
Buffered bike lanes	$347,760		$347,760
Narrow lanes + bike lanes	$5,203,875		$5,203,875
Narrow lanes + buffered or protected bike lanes	$1,937,700	$849,600	$2,787,300
Localized improvements			
Bicycle boulevard		$725,010	$725,010
Enhanced crossings	$255,000	$1,520,625	$1,775,625
Enhanced crossings and protected bike lanes		$1,114,200	$1,114,200
High visibility pavement markings		$220,950	$220,950
Intersection enhancements	$192,720	$250,800	$443,520
Intersection reconfiguration	$405,825		$405,825
Operational Modifications			
Speed management and signal modifications	$555,375		
Road Buffet			
Bicycle boulevard/Road buffet		$2,120,400	$2,120,400
Road buffet + buffered bike lanes	$3,228,300		$3,228,300
Road buffet + protected bike lanes		$18,111,975	$18,111,975
GRAND TOTAL	**$12,854,055**	**$26,295,510**	**$39,149,565**

SAFE MOBILITY PLAN NETWORK

The Safe Mobility Plan projects do not constitute a complete active transportation network. Instead, the individual projects correspond to the corridors and intersections with the highest concentration of collisions as described in Chapter 4. In many instances, the recommendations for high collision corridors will extend to the entire roadway, particularly where a given roadway has several high collision corridors. In other instances, the suggested improvements are localized for an intersection or roadway segment.

The Safe Mobility Santa Ana Proposed Active Transportation Network map on the following page identifies a broader network vision for enhanced safety. it identifies the full recommended project extents, along with several corridors for consideration as bike boulevards. The map on the following page identifies the method for impementing projects (e.g., lane narrowing or road buffet) rather than facility types; facility types are described in the cut sheets in Chapter 4 and the project table in Appendix B. This network vision identified in this map should be incorporated into a broader Active Transportation Plan.


Safe Mobility Santa Ana Proposed Active Transportation Network
Orange
Garden Grove
Westminster
Fountain Valley
Costa Mesa
Irvine
North Tustin
WESTMINSTER AV
HAZARD AV
BOLSA AV
EDINGER AV
MCFADDEN AV
W 5TH ST
W 1ST ST
W MEMORY LN
W SANTA CLARA AV
W 17TH ST
FAIRHAVEN AV
E SANTA CLARA AV
E 17TH ST
CIVIC CENTER DR W
W SANTA ANA BLVD
W MYRTLE ST
E 4TH ST
E 1ST ST
E CHESTNUT AV
E CUBBON ST
E MCFADDEN AV
E EDINGER AV
W HARVARD ST
W WARNER AV
E WARNER AV
W ADAMS ST
W SEGERSTROM AV
E DYER RD
W ALTON AV
W MACARTHUR BLVD
SUNFLOWER AV
N HARBOR BLVD
N JACKSON ST
N NEWHOPE ST
N EUCLID ST
N ENGLISH ST
N FAIRVIEW ST
N BRISTOL ST
N MAIN ST
N GRAND AV
N TUSTIN ST
N CABRILLO PARK DR
S SULLIVAN ST
S RAITT ST
S FLOWER ST
S BRISTOL ST
S FAIRVIEW ST
S GREENVILLE ST
S MAIN ST
S STANDARD AV
S GRAND AV
S LYON ST
HARBOR BLVD
FLOWER ST
BROADWAY
MAIN ST
Proposed Project Locations
Project Corridors
Project Intersections
Reference ID
Proposed Modification Type
Lane Narrowing
Road Buffet
Possible Extension
Potential Bike Boulevard
Operational Modifications
Localized Improvements
Add Bicycle Facilities
City Limits
0
0.5
1
Miles

APPENDICES

Appendix A. Collision Analysis Worksheets
Appendix B. Project Table
Appendix C. Countermeasure Toolbox
Appendix D. Collision Typing Tables