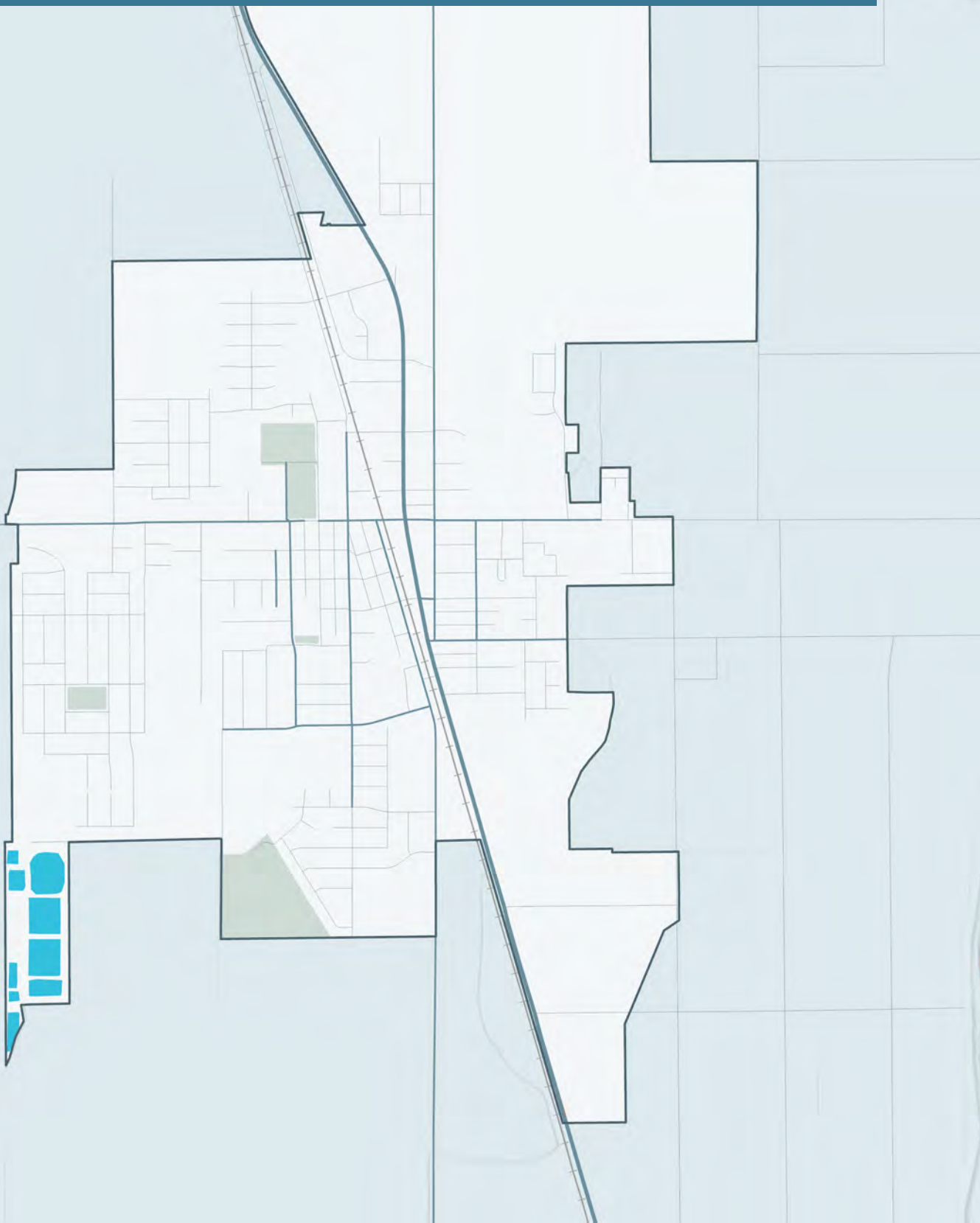




CHAPTER 10

Live Oak Crash Analysis



This Plan and Our Region

Introduction

Live Oak is a small city in northeast Sutter County, about 10 miles north of Yuba City and 50 miles north of Sacramento. It has a population of about 9,100. The city is surrounded by rich farmlands, orchards, the Feather River, and Sutter Buttes.

State Route 99 bisects the city, serving as a connection to nearby cities such as Yuba City. Pennington Road, another key corridor, traverses east-west through the city. The transportation system reflects the city's rural character, with limited but functional public transit options such as Yuba-Sutter Transit, which offers weekday round-trips to nearby cities like Yuba City and Marysville, along with several scheduled stops within Live Oak itself. For those traveling by car, the city is easily navigable, and recent infrastructure upgrades to SR 99 have made walking and biking much more viable in some areas.

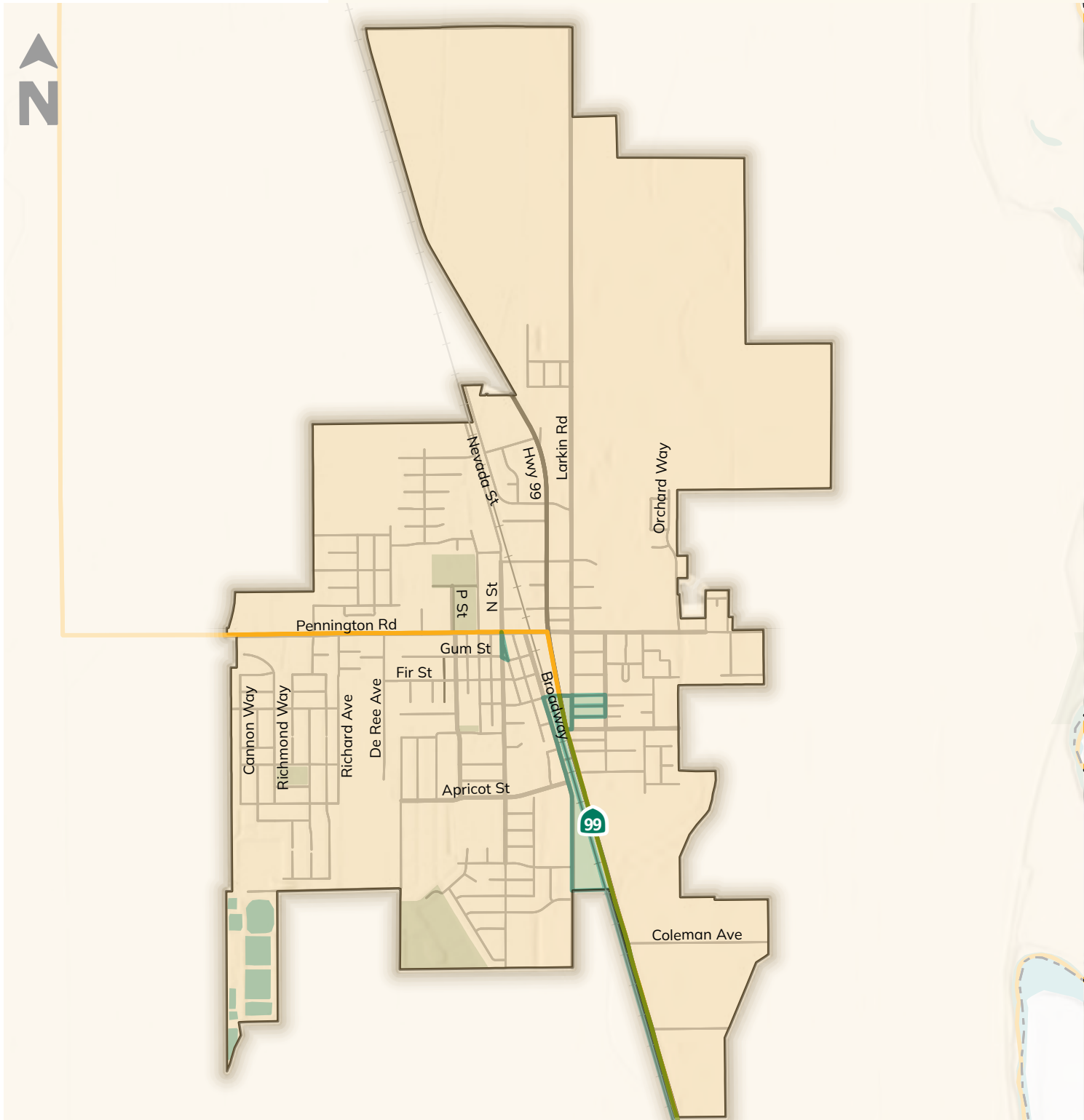
Communities of Concern

Sociodemographic data sources are helpful to better understand the community, as well as when applying for state and federal grant funding to implement infrastructure projects. Figure 10.1 shows locations in Live Oak that meet the criteria for two community metrics relevant to grant applications:

- Caltrans Transportation Equity Index (EQI) Transportation-Based Priority Populations: 0.4 percent of Live Oak's population meets Caltrans' threshold for Transportation-Disadvantaged status, compared to 16 percent statewide.
- USDOT Areas of Persistent Poverty and Historically Disadvantaged Communities: 100 percent of Live Oak's population lives in areas of persistent poverty and historically disadvantaged communities, compared to 28 percent statewide.

In CalEnviroScreen, which evaluates environmental burdens including air pollution, traffic density, and health vulnerabilities, Live Oak received a score of 31, where the state had a score of 23, indicating that the population of Live Oak experience higher levels of environmental impacts than the state as a whole.

Figure 10.1: Caltrans Transportation Equity Index & USDOT Areas of Persistent Poverty



Legend

- Caltrans Transportation Equity Index (EQI) Transportation-Based Priority Populations
- USDOT Areas of Persistent Poverty and Historically Disadvantaged Communities (APPHDC)

Projects

Live Oak has already demonstrated a commitment to roadway safety through the adoption of several plans, namely the Highway 99 Streetscape Master Plan, Bicycle, Pedestrian & Trails Plan and Circulation Element of the Live Oak General Plan. The Highway 99 Streetscape Master Plan is a long-range, multi-phase infrastructure and urban design strategy to transform SR 99 through Live Oak into a safer, more attractive, and multimodal corridor. The city's Bicycle, Pedestrian & Trails Plan establishes policies and identifies projects and programs to support a robust and safe network for people walking and biking, connecting them to community destinations. In addition, there are several policies within the Circulation Element that support roadway safety for all users.

Refer to **Appendix A** for a comprehensive list of policies that support the city's safety goals.

Projects

There are numerous infrastructure improvement projects currently underway or planned in Live Oak on state and local roadway facilities. These include the development of Class I off-street bikeways, the construction and reconstruction of roads with integrated sidewalks and bike lanes, and streetscape improvements along SR 99 as part of the Highway 99 Streetscape Master Plan's later phases.

Major safety improvements made to the Highway 99 corridor between Ramsdell Drive and Ash Street were completed in 2022, as part of the Highway 99 Streetscape Master Plan Phases 1 through 3.

INJURY CRASH TOTAL

108

KSI CRASH TOTAL

5

Figure 10.2
Injury Crashes by Year, 2018 - 2023

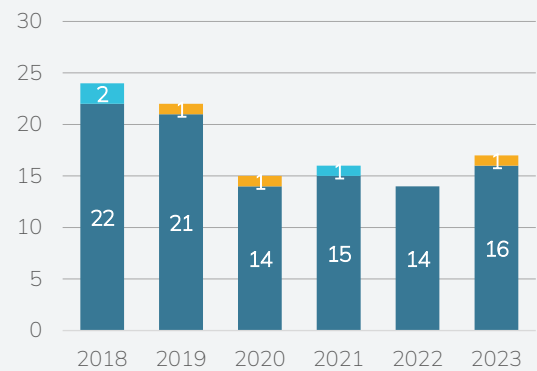
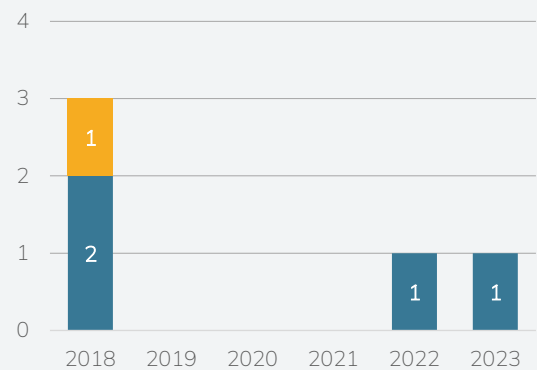


Figure 10.3
KSI Crashes by Year, 2018 - 2023



KSI = Killed or Severely Injured

- Vehicle-Only Crashes
- Bicycle-Involved Crashes
- Pedestrian-Involved Crashes

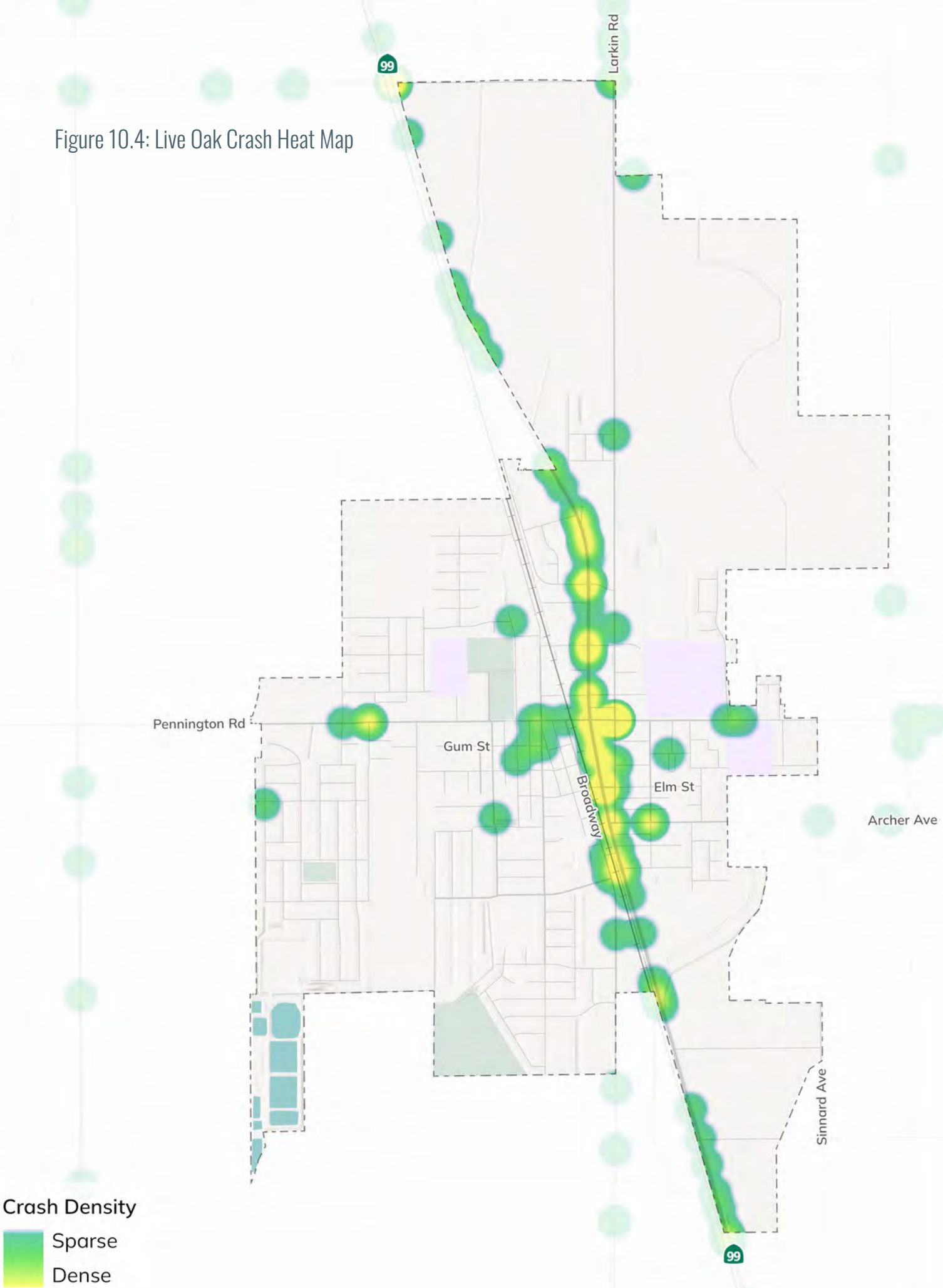
Crash Summary

This section summarizes key findings from the city’s crash data obtained from the California Highway Patrol’s Statewide Integrated Traffic Records System (SWITRS) database, for the years 2018 to 2023. The analysis includes all crashes that led to injury and excludes property-damage-only crashes.

Within the six-year period, Live Oak saw a total of 108 crashes that led to some degree of injury, three crashes (three percent of all injury crashes) involved bicyclists and three (three percent) involved pedestrians.

State Route 99/Nevada Street, Pennington Road/Larkin Road, and Live Oak Boulevard/Elm Street are hotspot intersections that saw a higher number of crashes than others. Notably, at the SR 99 and Nevada Street intersection, there are stop signs on Nevada Street, the side street, while the main corridor SR 99 is free-flow with a posted speed limit of 40 MPH. The Larkin Road and Pennington Road intersection is another hotspot location of concern, as it is near the high school.

Figure 10.4: Live Oak Crash Heat Map



About KSI Crashes

Severe injuries resulting from a traffic crash can result in a number of catastrophic impacts, including permanent disability, lost productivity and wages, and ongoing healthcare costs. These injuries can include:

- Broken or fractured bones
- Dislocated or distorted limbs
- Severe lacerations
- Severe burns
- Skull, spinal, chest or abdominal injuries
- Unconsciousness at or when taken from the collision scene

Throughout this analysis, the acronym KSI is used to denote crashes where someone was killed or severely injured.

KSI Crash Summary

Five out of 108 injury crashes in Live Oak resulted in a victim being Killed or Severely Injured (KSI). There was a total of two fatalities, both of which were a vehicle driver or passenger. All KSI crashes occurred on SR 99.

Figure 10.5
Crash Mode Share by Severity

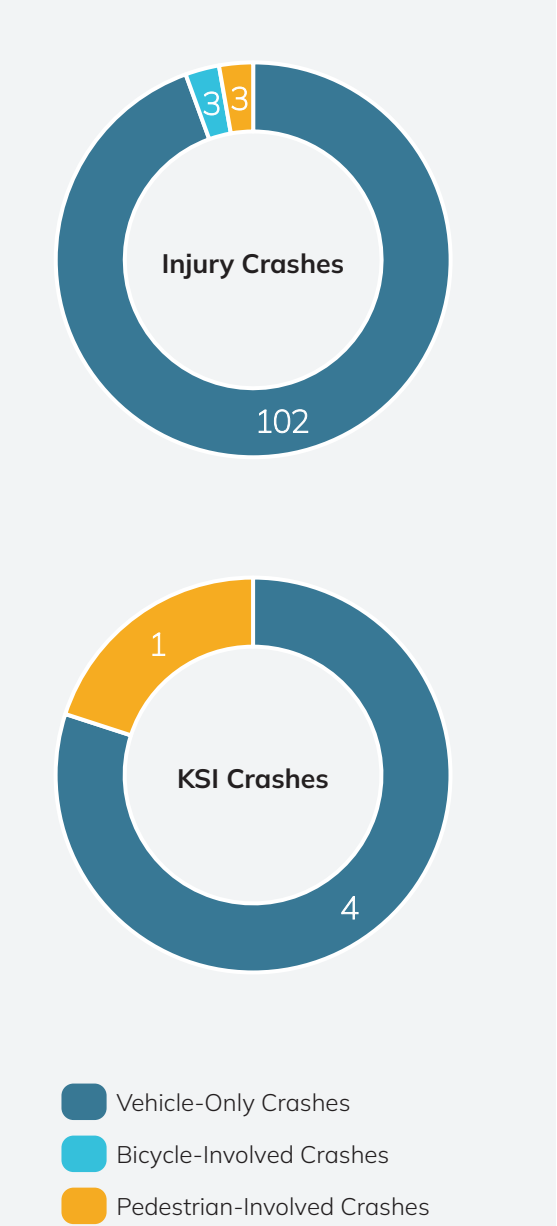
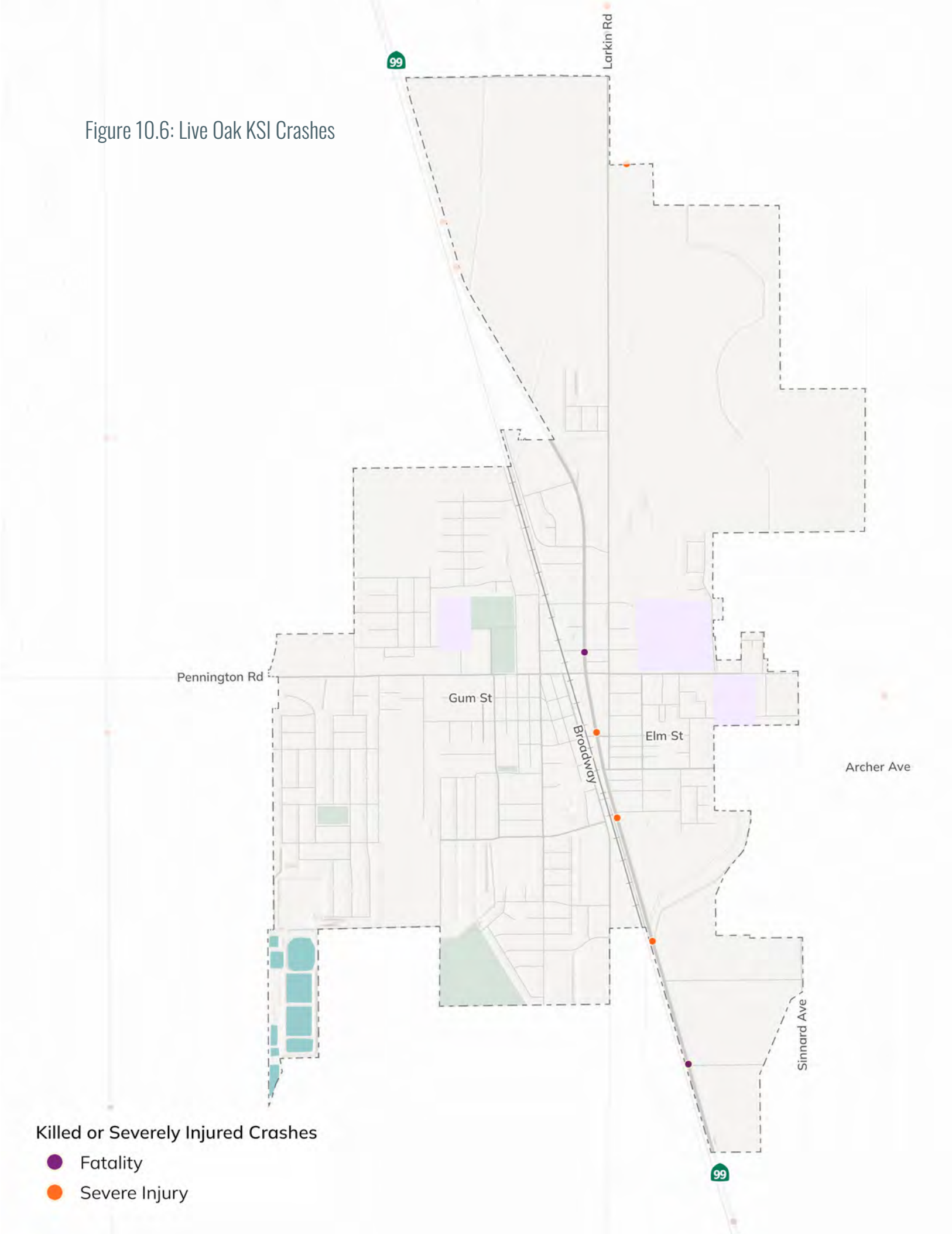


Figure 10.6: Live Oak KSI Crashes



Crashes by Crash Type

Overall, broadside (43 percent) and rear end (32 percent) crashes were the most common crash types, making up three-fourths of all injury crashes. Broadside crashes are typically the result of a failure to yield to oncoming traffic that have the right of way. Similarly, broadside crashes account for the majority of KSI crashes (three of five). The other two KSI crashes were hit object and vehicle/pedestrian.

Crashes by Primary Crash Factor

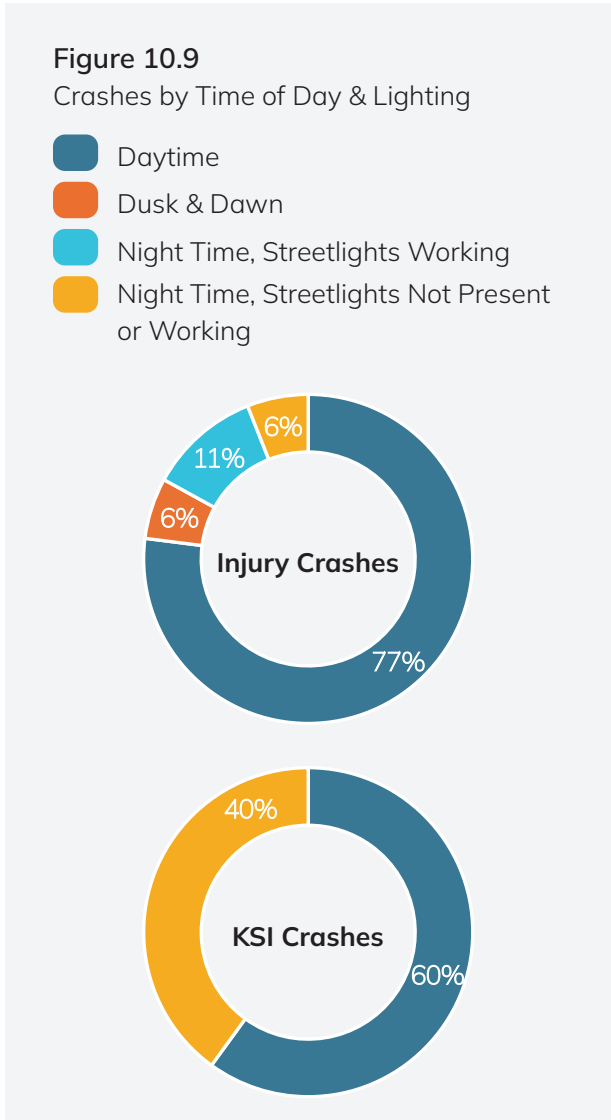
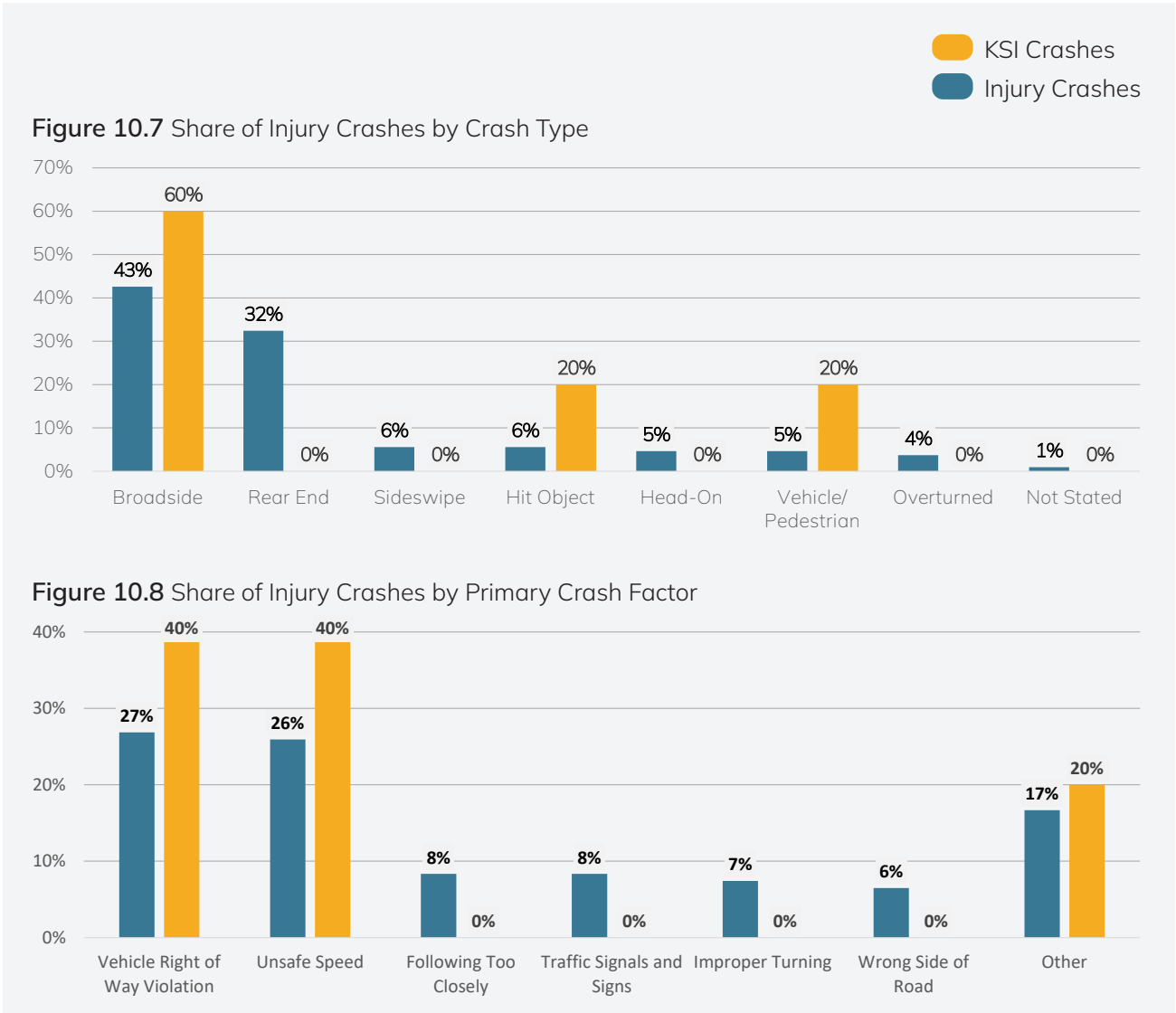
Vehicle right of way (27 percent) and unsafe speed (26 percent) were the leading reported primary causes of crashes resulting in injury. Additional causes included traffic signals and signs, following too closely, improper turning, and driving on the wrong side of road. Two KSI crashes were due to vehicle right of way and two due to unsafe speed. Another KSI crash was related to a pedestrian violation.

Crashes by Time of Day and Lighting Condition

Overall, most crashes occurred in daylight (77 percent), 11 percent occurred in the dark where streetlight was present, and 6 percent in the dark where streetlight was not present or working properly. A disproportionately greater share of KSI crashes occurred in the dark in areas lacking proper lighting, at 40 percent, while the other 60 percent occurred in daylight. 14 out of the 18 crashes that occurred under dark/no lighting conditions took place before the SR 99 improvements construction was completed in 2022.

Driving Under the Influence

Five percent of all crashes involved someone driving under the influence of alcohol or drugs. No KSI crashes involved a DUI.



Safety Corridors

Safety corridors are the roadway segments within Live Oak that had the highest number of crashes resulting in severe injury or death (KSI) in the six-year study period. Priority safety corridors are the safety corridors that experienced the highest rate of KSI crashes, are adjacent to sensitive land uses, and have high potential for severe crashes and thus, should be prioritized for improvements.

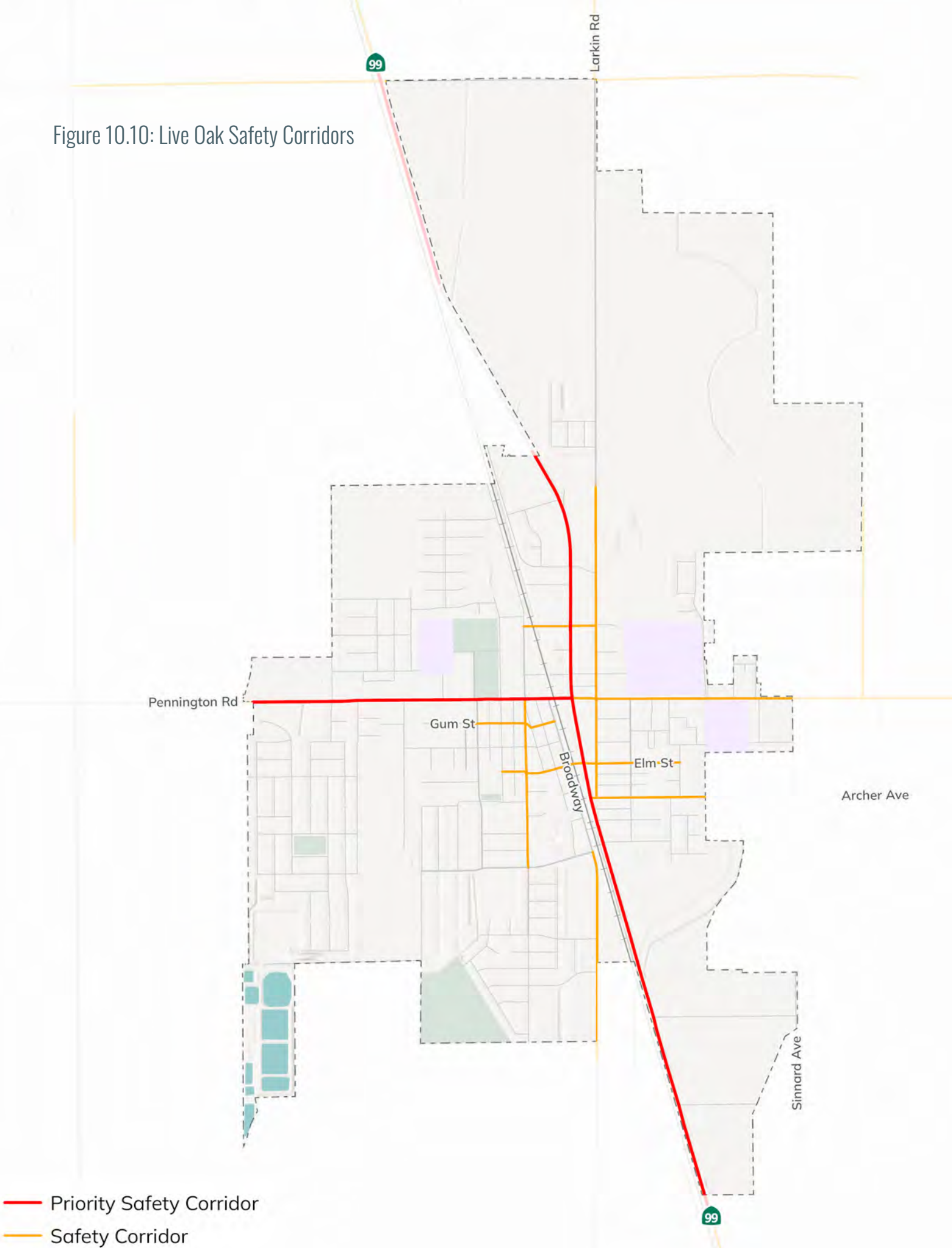
The following is a list of Live Oak’s priority safety corridors as identified through a safety corridor systemic analysis, task force input, and community feedback. Figure 10.10 displays Live Oak’s network of safety corridors, which are shown in orange. Priority corridors are shown in red. Refer to **Appendix C** for a more detailed explanation of the safety corridor identification technical methodology.

- State Route 99 from northern city limit to southern city limit
- Pennington Road from Live Oak Cemetery to SR 99

Priority Safety Corridors were identified to provide the list of locations for actionable next steps with additional study. Studies could include recommended engineering safety countermeasures with targeted improvements to address crash history or focused programs identified in the Action Plan chapter.



Figure 10.10: Live Oak Safety Corridors



Community Snapshot

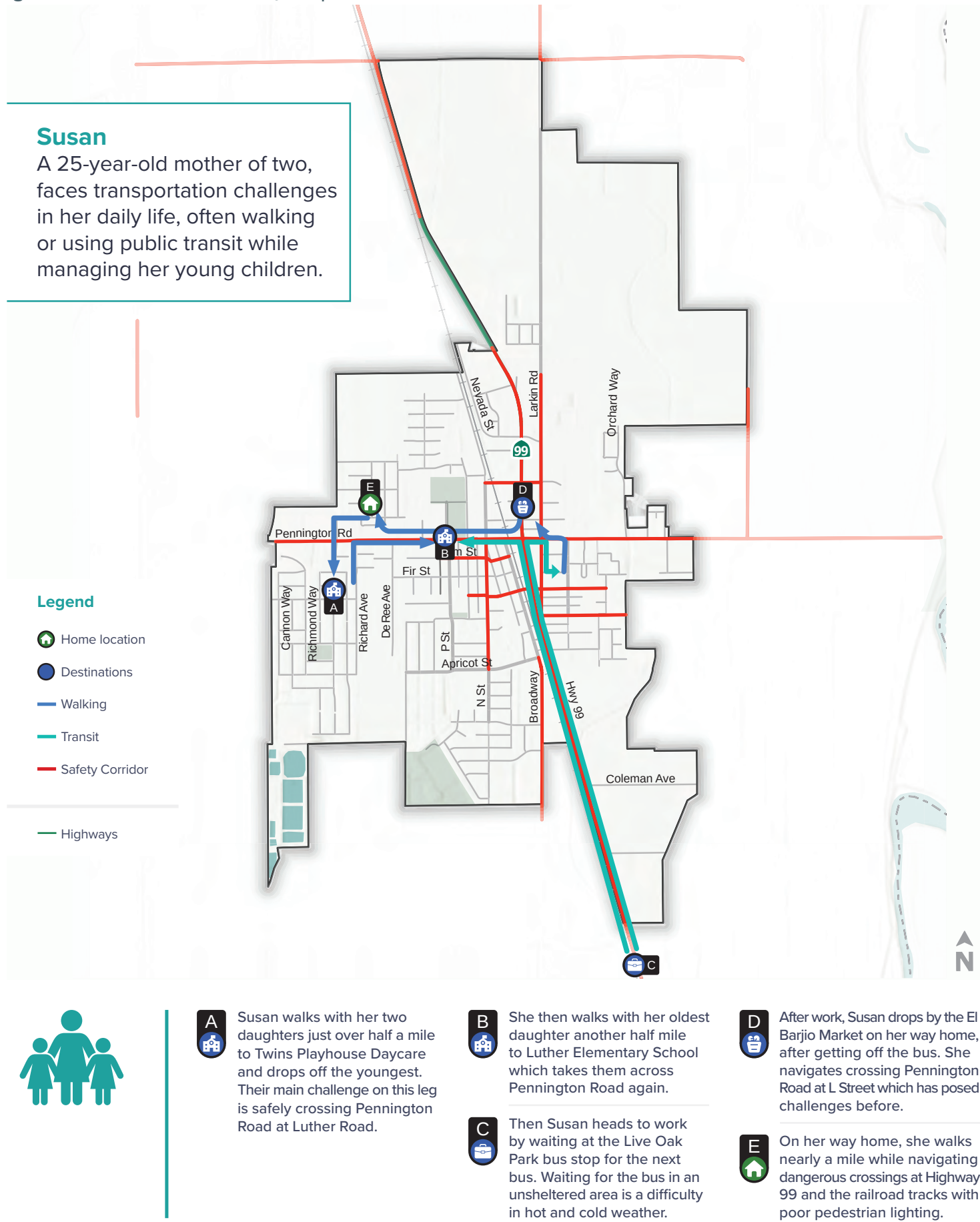
This community snapshot features Susan, a fictional character created to illustrate the daily transportation challenges faced by a mother without a personal vehicle in Live Oak. The experiences of this character are based on census data as well as local lived experiences.



Figure 10.11 illustrates the daily transportation journey of Susan, a 25-year-old mother of two, as she navigates her community without a personal vehicle. The map highlights key destinations for her: Twins Playhouse Daycare, Luther Elementary School, Live Oak Park bus stop, and El Bajio Market, along with the walking and transit routes she takes. Susan is met with several challenges in her daily commute, including dangerous crossings at major roads and railroad tracks and a lack of bus stop shelters and lighting, and long walking distances. Clearly, there is a need for improved infrastructure and safer, more accessible transportation options for families like hers.

Although a majority of trips in Live Oak are made by car (82 percent), a significant portion still travel on foot (15 percent). Susan’s experience highlights the broader challenges of inadequate infrastructure and limited mobility options in underserved communities, and how pedestrians should be given greater consideration when planning and implementing safety improvements.

Figure 10.11: Live Oak Community Snapshot





Focus Areas

Six focus areas were identified through a systemic analysis of crash records to represent the most significant patterns behind injury crashes—and especially KSI crashes—in the region. These focus areas are identified with the letters “A” through “F” and each one is applicable to one, several, or all of the communities covered by this RSAP. Following each crash focus area is a set of potential countermeasures that should be considered for implementation to improve safety outcomes. **Appendix D** contains a more detailed summary of each countermeasure.

Live Oak’s traffic safety challenges can be understood through a subset of these focus areas.



FOCUS AREA A
Crashes on State Highways Serving as
Main Streets



FOCUS AREA B
Right-of-Way Issues at Intersections



FOCUS AREA B

Crashes on State Highways Serving as Main Streets

INJURY CRASH STATISTICS

55 (51%) Total Crashes

3 (60%) KSI Crashes

State Route 99/Live Oak Boulevard is a north-south highway that serves as a main street in Live Oak. Major improvements were made to this corridor within the boundaries of the city between 2020 and 2022. These upgrades led to some positive safety outcomes, including a reduction in overall crash frequency. However, they also coincided with a gradual increase in the severity of crash outcomes. A later section presents a focused case study on the crash history of and improvements made to State Route 99.

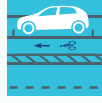
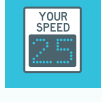
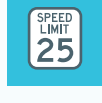
The following countermeasures can improve safety along highway main streets by slowing vehicle speeds, organizing traffic flow, and reducing conflict points between drivers, pedestrians, and bicyclists. Treatments like bike lanes, sidewalks, medians, and lighting enhance visibility and protection for vulnerable users like pedestrians and bicyclists, while speed management and intersection controls help lower the likelihood and severity of crashes. Together, these strategies can create safer conditions for all roadway users.



Figure 10.12: Crashes on State Highways Serving as Main Streets



Potential Countermeasures

- | | | | |
|---|---------------------------------|---|------------------------------------|
|  | All-Way Stop Control |  | Roundabout |
|  | Traffic Signal |  | Advance Stop Bar |
|  | Slow Turn Wedge |  | Separated Bikeways |
|  | Buffered Bike Lanes |  | Bike Lane |
|  | Add Sidewalk |  | Raised Median |
|  | Lane Narrowing |  | Road Diet |
|  | Driveway Consolidation |  | Speed Feedback Sign |
|  | Speed Limit Reduction |  | Street Lighting |
|  | Flashing Yellow Turn Phase |  | Advanced Dilemma Zone Detection |
|  | All-Red Signal Time |  | Speed Sensitive Rest in Red Signal |
|  | Retroreflective Tape on Signals | | |

Case Study

Live Oak Boulevard/State Route 99 Streetscape and Road Improvement Project

Recent safety improvements along the State Route 99/Live Oak Boulevard corridor in Live Oak’s downtown core area, between Nevada Street and Ash Street, serve as a compelling example of how State Highway “main street” improvements with safety countermeasures can lead to meaningful reductions in crash frequency and severity. This \$36 million project undertaken by Caltrans enhanced traffic safety and added multimodal improvements for the people walking and biking along this main street.



State Route 99/Live Oak Boulevard

Between July 2020 and April 2022, a series of improvements were constructed along SR 99 between Ash Street and north of Ramsdell Drive. These recent improvements were completed under Phases 1 through 3 as part of the Collaborative Highway 99 Streetscape Master Plan, a long-range, multi-phase infrastructure and urban design strategy to

transform SR 99 through Live Oak into a safer, more attractive, and multimodal corridor.

The roadway was rehabilitated to ensure a 40-year pavement life and improve driving conditions. Traffic signals were improved at key intersections of Pennington Road and Elm Street, and a new traffic signal was installed



📷 Upgrades along the corridor include lighting, landscaping, median islands, benches, trash bins, and bicycle racks

at Kola Street. The corridor was widened from two lanes to four lanes with either a median, two-way left-turn lane or room for left-turn pockets at intersections. A pedestrian-focused downtown environment was achieved via enhancements in parking, wayfinding signage, landscaping, and facilities for both bicyclists and pedestrians. New sidewalks with bulbouts, curbs, and gutters were constructed, and improvements were made to existing ones. Curb ramps were upgraded to meet current Americans with Disabilities Act (ADA) standards, ensuring greater accessibility for all users. Clay-colored stamped parking bays, decorative streetlamps, trees, and benches were added.

Within the study period of 2018 – 2023, a total of 52 crashes occurred along the segment of SR 99 that received improvements. The following information illustrates the crash reduction successes seen over time as improvements were implemented along the corridor segment, along with other changes in crash trends. To account for the varying time periods of the three construction stages, crash history is represented as a crash rate of the average number of crashes per month.



**BEFORE CONSTRUCTION
(JANUARY 2018 – JUNE 2020)**

Crash Rate: 1 per month

In the 30 months of the study period before construction began, the segment experienced 30 crashes, for a rate of 1 crash per month. Two of these crashes involved pedestrians, and two led to severe injury—one happening at Elm Street and the other on Ash Street. Clusters of crashes occurred in downtown Live Oak as well as the transition zones, areas closer to the edge of the city where travel speeds are higher as vehicles reached downtown. Rear-end (16 crashes) and broadside (11 crashes) emerged as the most frequent types of crashes that occurred. Unsafe speed (14 crashes), automobile right-of-way violation (six crashes), and following too closely (five crashes) were the primary causes behind pre-construction crashes. Overall, this time period saw crashes clustered around the Ramsdell Drive, Kola Court, Pennington Road, and Elm Street intersections.



**DURING CONSTRUCTION
(JULY 2020 – APRIL 2022)**

Crash Rate: 0.6 per month

In the span of 22 months in which construction took place, there were 14 crash occurrences, none of which involved pedestrians, bicyclists, or severe/fatal outcomes. Rear-end remained the top resulting crash type, accounting for 7 out of 14 crashes in this time period—3 of which occurred on Elm Street. Unsafe speed was the primary cause of 6 crashes, improper turning and vehicle right-of-way were each responsible for two crashes. Kola Street, Nevada Street, and Pennington Road experienced more than one crash.



**AFTER CONSTRUCTION
(MAY 2022 - DECEMBER 2023)**

Crash Rate: 0.4 per month

The months following the completion of construction saw a significant reduction in crash rates. There was a total of 8 crashes, for a rate of 0.4 crashes/month. There was a change in crash distribution patterns as more crashes occurred closer to the downtown area, and fewer in the transition zones. Speeding and rear end crashes were no longer the top primary cause and crash type. Instead, broadside became the most prominent type, making up 5 of the 8 crashes, and one of which led to a fatal outcome. 3 broadside crashes occurred at the Nevada, Ivy, and Ash Street intersections, the fatal crash happening at Ivy Street. The other two broadside crashes occurred on driveways between Pennington Road and Elm Street. One was caused by improper turning and the rest by vehicle right-of-way violation.

Safety enhancements along the State Route 99/Live Oak Boulevard corridor demonstrate the tangible benefits of safety-oriented infrastructure investment.

The project not only upgraded the roadway and improved accessibility and comfort for all users, but also significantly reduced crash frequency and severity—from 1 crash per month before construction to just 0.4 crashes per month after completion. No crashes involving people walking and biking occurred on the corridor once construction started, which can likely be attributed to the addition of adequate bicycle and pedestrian facilities. The improvements combine to create an overall vibrant downtown environment that likely induced traffic calming and a reduction of speed and rear end crashes, and crashes involving bicycle/pedestrian crashes. The new, improved, and continuous sidewalks and crosswalks bolster the feel of a multimodal corridor and signal to drivers that the road is a shared space for bicyclists, pedestrians, and vehicles alike. Clay-colored facilities, roadside landscaping, decorative street lighting, and other aesthetic design elements add visual interest that influences driving behavior by drawing drivers' attention to their surroundings other than just the road, causing them to slow down their driving. These results underscore the effectiveness of comprehensive safety countermeasures as well as thoughtful streetscape design.

However, the changes in crash trends were not all positive, and there is still work to be done.

Although rear-end crashes were substantially reduced, broadside rose as the most common type of crash after construction completed. Widening the road from two lanes to four lanes might have increased the risk of broadsides by increasing the time and distance needed to cross safely. The vehicles at fault in these crashes were making left and U-turns, and had to cross two lanes of oncoming traffic. This rise in broadside crashes is concerning because broadside crashes typically result in more severe outcomes than rear-end crashes, and usually account for a disproportionately greater share of KSI crashes. There is also increased speeding, which could possibly be attributed to the widening of the highway. As a result, short-term safety improvements along this corridor segment should prioritize addressing speeding and the causes of broadside collisions, particularly improper turning movements and right-of-way violations.

Collaborative Highway 99 Streetscape Master Plan - Later Phases

Building upon the improvements completed in Phases 1 through 3, the Later Phases of the Collaborative Highway 99 Streetscape Master Plan will extend safety, mobility, and aesthetic enhancements to the areas past the northern and southern limits of the city—identified as the New Growth Areas—which are planned for annexation. Later Phase improvements will focus on creating a safe and inviting complete streets environment through context-sensitive design, enhanced landscaping, improved pedestrian and bicycle infrastructure, and traffic calming strategies that reflect the community's small-town identity while supporting regional connectivity.

Observed post-construction crash trends along the Highway 99 corridor highlight important lessons for future design phases. These findings underscore both the strategies that should be reinforced and the design elements that should be reconsidered as Later Phase improvements advance in tandem

with the planned development surrounding Live Oak. Encouragingly, several of the planned enhancements already align with Caltrans' Design Information Bulletin (DIB) 94: Complete Streets – Contextual Design Guidance, which emphasizes context-sensitive, multimodal safety. For example, the plan's strategy to limit ingress and egress along the corridor directly supports DIB 94 principles by reducing potential conflict points between vehicles, pedestrians, and cyclists. This access management approach is expected to mitigate crash risk at driveways and intersections, (i.e. broadside crashes) while simultaneously fostering a safer, more predictable travel environment for all corridor users. The following improvements are recommendations informed by the crash patterns that emerged from earlier improvement phases of Live Oak's streetscape improvement project as well as Caltrans' DIB 94 guidance.

Collaborative Highway 99 Streetscape Master Plan - Later Phases Improvement Recommendations

Speed Management and Traffic Calming

- Narrow lanes where feasible to reduce operating speeds while maintaining freight mobility.
- Provide gateway treatments (landscaping, textured pavements, vertical features, or raised medians) at city entrances to reinforce appropriate speed expectations.
- Install traffic calming elements such as curb extensions, pedestrian refuge islands, and raised or textured crosswalks at frequent intervals
- Implement progressive speed management zones supported by speed feedback signs and roadway design cues to transition drivers from higher rural highway speeds to lower community speeds.

Intersection Safety and Conflict Reduction

- Where feasible, consider protected left-turn phasing, roundabouts, or raised medians to address broadside crash risk.
- Provide high-visibility crosswalks, upgraded lighting, and advance warning signage at all major intersections.
- Apply access management strategies, including driveway consolidation, to minimize turning movement conflicts along the corridor.

Multimodal Separation and Protection

- Increase the frequency of pedestrian crossings: approximately 500 feet in New Growth Areas, where feasible.

Context-Sensitive Design Application

- Where feasible, emphasize human-scaled design, including narrower lane widths, enhanced pedestrian amenities, and consistent streetscape elements, to reinforce low-speed, multimodal travel.
- At community gateways, integrate placemaking features that signal a transition from high-speed highway conditions to a small-town, pedestrian-oriented environment.





FOCUS AREA B

Right-of-Way Issues at Intersections

INJURY CRASH STATISTICS

31 (29%) Total Crashes

2 (40%) KSI Crashes

A total of 31 crashes (29 percent) occurred at intersections where the primary cause was failure to yield the right-of-way. Of these 31 crashes, 2 resulted in a KSI crash. These incidents stemmed from drivers failing to yield to oncoming or cross traffic that legally possessed the right-of-way. In many cases, motorists either misjudged the speed and distance of approaching vehicles or did not come to a complete stop at the appropriate distance from the main thoroughfare. As a result, all but one culminated in a broadside, or T-bone, crash—an especially dangerous type of crash. These types of crashes are often severe due to the limited protection on the sides of vehicles, highlighting the critical importance of right-of-way compliance at intersections.

Crashes with these right-of-way issues tended to involve vehicles pulling out of driveways, and intersections where side streets are controlled by stop signs, while the main thoroughfare was uncontrolled. Most of these occurred along SR 99 and Pennington Road.

The following countermeasures directly target right-of-way issues by making intersections safer, more predictable, and easier to navigate. Treatments such as roundabouts, traffic signals, and protected left turns mitigate crash risks by clarifying priority. Design features like lane narrowing and intersection tightening further slow vehicles down, reducing impact upon collision. High-visibility crosswalks, bike lanes, and pedestrian beacons enhance visibility of vulnerable roadway users and right-of-way compliance.



Figure 10.13: Crashes with Right-of-Way Issues at Intersections



Potential Countermeasures

	Roundabout		Traffic Signal
	Neighborhood Traffic Circle		Intersection Reconstruction and Tightening
	Slow Turn Wedge		Advance Stop Bar
	Raised Median		Centerline Hardening
	Lane Narrowing		Through Bike Lane at Intersection
	Rectangular Rapid Flashing Beacon		Pedestrian Hybrid Beacon
	High-Visibility Crosswalk		Advanced Dilemma Zone Detection
	Protected Left Turns		Flashing Yellow Turn Phase
	All-Red Signal Time		

